OLD ENGLISH HIGH VOWEL DELETION IN STOCKING FEET

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1. Overview

The foot structure of Old English as described by Dresher and Lahiri (1991, 2005), and in particular its role in determining the environment for a process of high vowel deletion, poses a challenge for the system of prosodic representations proposed by Hall (2001, 2005). The purpose of this paper is first to outline the problem, and then to show how it can be overcome by positing that high vowel deletion occurs as part of the procedure for parsing metrical feet, rather than afterward.

The approach to metrical structure pursued here is based on the Simplified Bracketed Grids proposed by Idsardi (1992) and Halle and Idsardi (1995). In this general framework, prosodic boundary symbols are treated as entities in their own right, which are thus directly manipulable by the phonological computation, rather than simply being the edges of the constituents they delimit. One consequence of this is that left and right delimiters, represented by left and right parentheses, need not always appear in matched pairs—for example, it is possible for an unmatched parenthesis to be present in the underlying representation of a form, or to be inserted by a rule. A corresponding boundary at the opposite end of the constituent may be inserted later, or may simply remain implicit.

Separator theory (Hall 2001; Reiss 2003; Hall 2005) attempts to simplify metrical grid structures even further, by eliminating the distinction between left and right boundaries. Instead of left and right parentheses, a single separator symbol `|` is used, metaphorically clothing metrical feet in socks as opposed to shoes. One consequence of this reduced set of symbols is that it constrains the range of possible relations that can be explicitly encoded as holding between two grid marks. As discussed by Hall (2001: 50), Simplified Bracketed Grids allow for the three possibilities illustrated in (1), which correspond to the single separator-theoretic representation in (2):

(1) a. `X)Y` 'X belongs to a constituent that does not include Y.'
b. `X(Y` 'Y belongs to a constituent that does not include X.'
c. `X)(Y` 'X and Y belong to two different constituents.'

(2) `X|Y` 'X and Y do not belong to the same constituent.'

If X and Y are both assumed to be parsed into larger constituents, then the four representations in (1) and (2) all amount to the same thing. If, however, it is possible that either X or Y is unparsed, then the distinctions in (1) become potentially important: in (1a), Y may be unparsed; in (1b), X may be unparsed; and in (1c), both X and Y are parsed.

The account of Old English high vowel deletion given by Idsardi (1994) relies on the notion that the deleted vowels are always in unfooted syllables. In

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this paper, I argue that high vowel deletion can be accounted for in separator theory using a foot structure based on the Germanic Foot proposed by Dresher and Lahiri, with no recourse to unfooted syllables.

2. Theoretical assumptions

The particular version of separator theory assumed here is that of Hall (2001, 2005), in which the constituents on each line of the metrical grid are as shown in (3).

```
(3)  line 2 = word stresses and word boundaries:   |x
     line 1 = stressed moras and foot boundaries:  |x   |x  |
     line 0 = moras and syllable boundaries:       |xx|x|x|x|xx|
```

Because line 0 of the metrical structure contains moras and syllable boundaries, rather than syllables and foot boundaries (as in Halle and Vergnaud (1987) and Idsardi (1992), among others), heavy syllables are distinguished from light ones by the number of adjacent grid marks, rather than by a distinction between the symbols `H` and `L`, and the process of grouping syllables into feet consists in projecting line-0 separators to line 1, rather than inserting boundaries in line 0. The example in (3) shows a five-syllable word in which the first and last syllables are heavy; the first and third syllables are stressed, with the main stress on the first. Syllables one and two are grouped into a foot, as are syllables three and four; syllable five is depicted ambiguously as either unfooted or constituting a monosyllabic (and unstressed) foot.

3. The facts to be accounted for

3.1 The Germanic foot

The Germanic foot of Old English is "a resolved and expanded moraic trochee" (Dresher and Lahiri 2005: 79; Fikkert, Dresher, and Lahiri 2006: 127); or, viewed another way, it consists of a canonical iamb (as per Hayes (1995)) plus an optional light syllable (Idsardi 1994: 523):

(4) $$\left\{ \begin{array}{c} \mathrm{LH} \\ \mathrm{LL} \\ \mathrm{H} \end{array} \right\} (\mathrm{L})$$

For Dresher and Lahiri (1991), the structure in (4) comprises an obligatory strong left branch of at least two moras and at most two syllables (i.e., LH, LL, or H), plus an optional weak right branch consisting of a single light syllable. Within the framework of bracketed grids adopted here, there is no mechanism for delimiting constituent structure intermediate between the syllable and the foot levels, so there is no way to represent the members of a disyllabic left branch of a foot as a unit separate from the right branch if there is one. Accordingly, the Germanic foot will be represented here simply as a foot containing one, two, or three syllables.

3.2 Stress

In Old English, main stress is generally word-initial.[1] Secondary stresses occur on the initial syllables of non-initial feet, with the proviso that word-final syllables do not bear stress.

The examples in (5) illustrate some words analyzed as consisting of a single Germanic foot by Dresher and Lahiri, together with the separator-theoretic representations that are assigned to them by the algorithm to be proposed in §4.

(5) Words of one foot (Dresher and Lahiri 2005: 80):

a. 'words' (GEN.PL.)
(H́L)
```
|x
|x   |
|xx|x|
```
wór.da

b. 'troops' (GEN.PL.)
(ĹLL)
```
|x
|x     |
|x|x|x|
```
wé.ru.da

c. 'kings' (GEN.PL.)
(ĹHL)
```
|x
|x       |
|x|xx|x|
```
cý.nin.ga

The examples in (6) show the alternation between unstressed and secondarily stressed realizations of initial syllables of non-initial feet when they occur in word-final and non-final positions. In (6b), the syllable *ðèr* is made non-final by the presence of a following syllable within the same foot; in (6d), the syllable *lìn* is made non-final by a following heavy syllable, which is parsed into a separate foot (and which itself would be stressed if it were not word-final).

(6) Stress on non–word-final foot heads (Dresher and Lahiri 2005: 80):

a. 'other'
(H́)(H)
```
|x
|x  |
|xx|xx|
```
ṓ.ðer

b. 'other' (M.ACC.SG.)
(H́)(H̀L)
```
|x
|x  |x    |
|xx|xx|x|
```
ṓ.ðèr.ne

c. 'prince'
(ĹL)(H)
```
|x
|x   |
|x|x|xx|
```
ǣ́.ðe.ling

d. 'prince' (GEN.SG.)
(ĹL)(H̀)(H)
```
|x
|x   |x  |
|x|x|xx|xx|
```
ǣ́.ðe.lìn.ges

3.3 High vowel deletion

Deletion applies to high vowels only in supernumerary foot-final light syllables—that is, in what Dresher and Lahiri describe as the right branch of the Germanic foot. Some examples of the environment in which high vowel deletion occurs are shown in (7).

[1] Exceptions to this generalization about main stress arise from the addition of non–stress-bearing prefixes to verbs.

(7) Examples in which deletion occurs (Dresher and Lahiri 2005: 80):

a. ‘head’ (DAT.SG.)

```
|x
|x     |
|xx|x|x|
```
hḗa.fu.de
↓
hḗafde

b. ‘words’ (NOM./ACC.PL.)

```
|x
|x     |
|xx|x|
```
wór.du
↓
wórd

c. ‘troops’ (NOM./ACC.PL.)

```
|x
|x      |
|x|x|x|
```
wé.ru.du
↓
wérud

In (7a) and (7b), the vowel *u* occurs in a light syllable that immediately follows a word-initial heavy syllable. As in (5a), a light syllable in this context can be parsed into the same foot as the preceding heavy syllable; however, the heavy syllable is sufficient to form a foot by itself. In (7c), the deleted vowel is in the third of three light syllables in a row. These can also be parsed as a single foot, but the third syllable is supernumerary. Both the height of the vowel and the position of the syllable in which it occurs are crucial: note that the low vowel *a* does not delete in (5a), although it occupies the same position as the deleted *u* in (7b), and that the *u* in the second syllable of (7c) does not delete, even though it is high.

The examples in (8), in which no deletion occurs, further illustrate the role of syllable weight and position within the foot in determining the applicability of the rule:

(8) Examples with no deletion (Dresher and Lahiri 2005: 80):

a. ‘words’ (DAT.PL.)

```
|x
|x  |
|xx|xx|
```
wór.dum

b. ‘praises’ (NOM./ACC.PL.)

```
|x
|x
|x|x|
```
ló.fu

c. ‘animals’ (NOM./ACC.PL.)

```
|x
|x     |
|xx|x|x|
```
nī́.te.nu

In (8a), the *u* is not deleted because it is in a heavy syllable (cf. (7b)). In (8b), the *u* is in a light syllable, but there is only a single light syllable preceding it in the foot, so it is not supernumerary (cf. (7c)). In (8c), the *u* is not deleted because it is not in the first foot at all: the initial heavy syllable makes up the strong left branch of the foot, and the light syllable *te* is the optional weak branch, so the final *nu* cannot be parsed into the same foot.[2]

Among other things, the structure Dresher and Lahiri assign to the Germanic foot neatly explains the otherwise mysterious relation between the weight of the first syllable and the possibility of deletion in the last in examples such as (7b,c) and (8b,c).

4. The analysis

4.1 Knitting the socks

Separator-based representations for Old English, like the ones shown in (5)–(8), can be generated fairly straightforwardly by the procedure shown in (9).

(9)

1. **Parse Germanic Feet** (stop whenever an instruction would go beyond the right edge of the word):
   (a) Start at the left edge of the word, and project the first boundary.
   (b) Skip over the next two grid marks to the right.
   (c) i. If now at a boundary, stay there;
       ii. otherwise, proceed to the next boundary to the right.
   (d) i. If at the beginning of a heavy syllable (i.e, if /__ `xx`), project the current boundary;
       ii. otherwise, go to the next boundary to the right, and project it.
   (e) Go to step **1b**.
2. **Feet are left-headed:** Project each line-0 grid mark that immediately follows a line-1 boundary (unless it is in the last syllable of the word).[3]
3. **Words are left-headed:** Project the leftmost line-1 boundary, and the line-1 grid mark to its immediate right.

Steps 1b–1c capture {LH, LL, H} as a natural class by first parsing two moras, then parsing one additional mora if and only if there is no syllable boundary immediately after the first two.

Step 1d deals with what happens after a canonical iamb has been parsed—if the next syllable is heavy, it must begin a new foot, but if it is light, it can and will be incorporated into the current foot, and the syllable after it will begin the next foot.

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[2] The representation assigned to (8c) is ambiguous as to whether *nu* constitutes a degenerate foot or is simply unfooted; the difference between these two possibilities does not matter for either stress assignment or high vowel deletion, since final syllables are never stressed in any case, and only supernumerary syllables within a foot are subject to deletion.

[3] Alternatively, we could simply project all foot-initial grid marks to line 1 here, and then delete the stress from word-final syllables either by rule or in phonetic implementation.

4.2 The challenge

The problem with the representations assigned by (9) is that they do not provide a good way of identifying which high vowels are subject to deletion.

From the data in (7) and (8), it might appear that the relevant structural information is provided by the presence or absence of a foot boundary: the deleted high vowels in (7) are followed by boundaries on line 1, while the retained high vowels in (8) are not. However, not all high vowels that precede foot boundaries are deleted, as can be seen by comparing *wérudum* in (10a) with *hḗafde*, repeated from (7a), in (10b):

```
(10)  a.  |x              b.  |x
          |x  |               |x   |
          |x|x|xx|            |xx|x|x|
          wé.ru.dum           hḗa.fu.de
             ↓                    ↓
          wérudum             hḗafde
```

The *ru* of (10a) and the *fu* of (10b) are both followed by foot boundaries, but for different reasons:

- *ru* in (10a) is to the left of a foot boundary because *dum* is heavy and must begin a new foot. (If the third syllable were light, it could have been parsed as part of the first foot.)
- *fu* in (10b) is to the left of a foot boundary because the foot that contains it cannot contain any more material. (If the initial syllable had been light, then the light third syllable could have been parsed as part of the first foot.)

Given unpaired left and right parentheses, as in Idsardi's (1992) version of simplified bracketed grid theory, it would be easy to mark this difference: the procedure could insert a left foot boundary to the left of a heavy syllable that forces it to begin a new foot (in step 1(d)i), but insert a right foot boundary to the right of a light syllable that forces us it close off the current foot (in step 1(d)ii). This would produce representations like the ones in (11), which would make it possible to formulate high vowel deletion as the deletion of a short high vowel immediately before a right foot boundary.

(11) a. `(we.ru(dum` → *wérudum*
  b. `(hēa.fu)de` → *hḗafde*

Idsardi (1994) offers another treatment of Old English high vowel deletion that also relies on the distinction between left and right brackets. Rather than employing Dresher and Lahiri's Germanic foot, Idsardi (1994) treats the supernumerary light syllables as unfooted. High vowel deletion in his analysis thus consists of the deletion of high vowels in unfooted syllables, as in (12):

(12) Deletion of unfooted high vowels (Idsardi 1994: 525):

a. `(wor)du` → *wórd*

b. `(wor)(dum)` → *wórdum*

c. `(hēa)fu(des)` → *hḗafdes*

d. `(weru)du` → *wérud*

e. `(lofu)` → *lófu*

In separator theory, the representations in (11) and (12) are unavailable. The information about whether a syllable is supernumerary is not encoded in the output of the procedure in (9). After the footing procedure is complete, the only way to identify supernumerary light syllables would be to go back and count the moras preceding them in the same foot.

4.3 The solution

While the procedure is running, however, this information is encoded in its current state: when the procedure is at the beginning of step 1d, an immediately following light syllable is a potential target for deletion (provided its vowel is high).

Accordingly, we can build high vowel deletion into the footing procedure as in (13), in much the same way that Itô (1989) builds epenthesis into syllabification in Temiar and in different varieties of Arabic. The crucial addition is step 1(d)ii.

(13)

1. **Parse Germanic Feet** (stop whenever an instruction would go beyond the right edge of the word):
   - (a) Start at the left edge of the word, and project the first boundary.
   - (b) Skip over the next two grid marks to the right.
   - (c) i. If now at a boundary, stay there;
     - ii. otherwise, proceed to the next boundary to the right.
   - (d) i. If at the beginning of a heavy syllable (i.e, if /__ `xx`), project the current boundary;
     - ii. **otherwise, if the vowel to the right is high, delete it and its grid mark, and conflate and project the two boundaries that are thereby made adjacent;**
     - iii. otherwise, go to the next boundary to the right, and project it.
   - (e) Go to step **1b**.
2. **Feet are left-headed:** Project each line-0 grid mark that immediately follows a line-1 boundary (unless it is in the last syllable of the word).
3. **Words are left-headed:** Project the leftmost line-1 boundary, and the line-1 grid mark to its immediate right.

The examples below show how this revised algorithm applies in a few representative cases. (14) and (15) give derivations for the words in (10); (16) illustrates the application of high vowel deletion in an LLL foot in (7c); and (17) shows how an LHL sequence is parsed as a single foot as in (5c). In each example, newly deleted material is shown struck through with diagonal lines; a triangular cursor at the bottom of each form indicates the column in the metrical grid that is being considered by the algorithm at each step.

(14) High vowel deletion in *hḗa.f~~u~~.de:*

```
STEP:    1(a)        1(b), 1(c)i   1(d)ii        1(d)ii
line 2:
line 1:  |           |             |             |   |
line 0:  |xx|x|x|    |xx|x|x|      |xx|~~x~~|x|  |xx|x|
         △                 △             △             △

STEP:    2
line 2:
line 1:  |x  |
line 0:  |xx|x|
          △

STEP:    3
line 2:  |x
line 1:  |x  |
line 0:  |xx|x|
          △
```

(15) No high vowel deletion in *wé.ru.dum:*

```
STEP:    1(a)        1(b), 1(c)i   1(d)i         1(b)
line 2:
line 1:  |           |             |    |        |    |
line 0:  |x|x|xx|    |x|x|xx|      |x|x|xx|      |x|x|xx|
         △               △             △                  △

STEP:    2
line 2:
line 1:  |x   |
line 0:  |x|x|xx|
          △

STEP:    3
line 2:  |x
line 1:  |x   |
line 0:  |x|x|xx|
          △
```

(16) High vowel deletion in *wé.ru.d~~u~~:*

```
STEP:    1(a)       1(b), 1(c)i   1(d)ii         1(d)ii
line 2:
line 1:  |          |             |              |   |
line 0:  |x|x|x|    |x|x|x|       |x|x|~~x~~|    |x|x|
         △               △             △              △
```

```
STEP:    2
line 2:
line 1:  |x   |
line 0:  |x|x|
          △

STEP:    3
line 2:  |x
line 1:  |x   |
line 0:  |x|x|
          △
```

(17) Parsing an ĹHL foot in *cý.nin.ga:*

```
STEP:    1(a)          1(b)          1(c)ii         1(d)iii
line 2:
line 1:  |             |             |              |          |
line 0:  |x|xx|x|      |x|xx|x|      |x|xx|x|       |x|xx|x|
          △                 △              △                   △

STEP:    2
line 2:
line 1:  |x       |
line 0:  |x|xx|x|
          △

STEP:    3
line 2:  |x
line 1:  |x       |
line 0:  |x|xx|x|
          △
```

5. Consequences and alternatives

5.1 High vowel deletion and metrical parameters

The analysis presented here offers a way of treating Old English metrical structure using bracketed grid structures that are even further simplified from those of Idsardi (1992). However, incorporating processes such as high vowel deletion into procedures for assigning metrical structure makes it harder to treat cross-linguistic variation in stress systems as purely parametric. A main goal in work on prosodic structure has been to identify limits on the range of possible systems by reducing the definitions of footing algorithms to a set of simple choices: feet are binary or unbounded; footing proceeds from left to right or from right to left; feet are left- or right-headed; and so on. Idsardi (2005) shows how metrical parameters of this sort can be translated into pieces of finite-state automata for building metrical structure; to construct an automaton for a given language, one simply combines the modules corresponding to each of its parameter settings. At least in principle, it should be possible to extend this approach to the kinds of structure-changing segmental rules that are typically driven by prosody: high vowel deletion in Old

English, for example, and epenthesis in many languages, could be represented as additional modules that can be incorporated into the machine that assigns metrical structure to underlying forms.

5.2 Optimality Theory

The primary aim of this paper has been to demonstrate that an account of Old English high vowel deletion is possible given the relatively sparse system of representations posited by separator theory. The analysis presented here has been a derivational one, but it is also worth considering whether a separator-theory treatment of Old English would also be possible in a constraint-based framework such as Optimality Theory (Prince and Smolensky 1993).

In traditional Optimality Theory, the phonological computation consists of a single harmonic evaluation. At least one aspect of the analysis proposed here, then, would have to be carried over into an Optimality Theoretic account: high vowel deletion would necessarily occur as part of the same computation that calculates foot structure, rather than after it.

Other aspects of the present analysis, however, would be more difficult to carry over into a constraint-based framework. The algorithm in (13) proceeds locally and short-sightedly; when it deletes a high vowel in step 1(d)ii, it does so without regard for the effect this will have on the overall prosodic structure. In Optimality Theory, however, output candidates are evaulated globally, and it would not be an easy task to recreate in constraint-based terms the derivational mechanism that yields, for example, deletion in the third syllable of *wérudu* (7c) but not in the third syllable of *nī́tenu* (8c). In the algorithm in (13), a high vowel in a light syllable is deleted in exactly the environment in which a light syllable with a non-high vowel could, and would, be included as a supernumerary syllable at the end of a foot: *weruda* is parsed as a single foot *wéruda* and *werudu* is parsed as a single foot *wérud.* The *nu* of *nī́tenu,* in contrast, cannot be parsed into the same foot as the first two syllables, and in the algorithm in (13), this is why its vowel is not deleted. In the surface-oriented framework of Optimality Theory, though, it would be difficult to explain why the final vowel of *wérudu* is deleted when LLL feet are generally permissible, but the final vowel of *nī́tenu* is retained even though it results in either a degenerate foot or an unfooted syllable. Any attempt to recast the present analysis in Optimality Theoretic terms would necessarily involve substantive changes and contend with non-trivial difficulties.

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