論文

Back Mutation in Old English

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1 Introduction

This paper examines the phonological process that is referred to as Back Mutation in Old English (OE) from the standpoint of Optimality Theory (OT), a constraint-based linguistic theory (cf. Prince and Smolensky, 1993; Kager, 1999; McCarthy, 2000). What the present analysis focuses on is the status of short diphthongs. I will argue that the occurrence of unstressed [+back] epenthetic vowels is explained as a consequence of constraint interaction, within the parallel system of OT that lacks numerous intermediate representations between the input and the output that exist in a serial derivational approach.

This article proceeds as follows. Section 2 discusses the representation of OE vowels (monophthongs and diphthongs) and their prosodic properties. Section 3 gives some basic notions about the OT grammar. In Section 4 we turn to Back Mutation in OE and show how this phenomenon can be explained, focusing on Corresponding Theory developed by McCarthy (1995). Section 5 is allotted to an examination of exceptional and problematic cases. Section 6 will recapitulate the entire discussion.

2 OE Phonology

2.1 Prosodic Structure in OE

It is often pointed out that languages can be divided into two types in view of their characteristics in rhythmic structure: stress-timed languages and syllable (mora)-timed languages. For instance, Present-day English is considered to belong to the former group and Japanese to the latter. Looking back into the history of English, we find OE to have behaved as a mora-timed language.

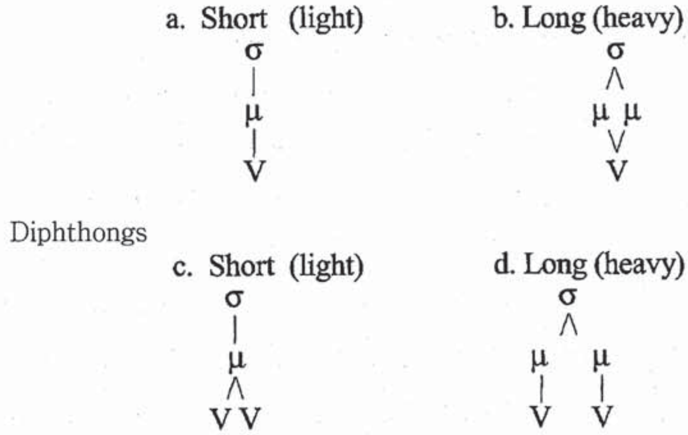
First, let us begin with a review of OE vowels. There have been controversies in the literature of historical phonology as to how diphthongs, especially short ones, should be best represented. Among them, Lass (1994) points out four types:

(1) a. Short vowels: *eft* 'again', *ræft* 'rat'
b. Long vowels: *fēt* 'feet', *glǣm* 'gleam'
c. Short diphthongs: *eolh* 'elk', *fleax* 'flax'
d. Long diphthongs: *fēond* 'fiend' *sēam* 'seam' (Lass, 1994: 45)

There is a strong correlation between the weight of a vowel and its internal structure. Lass (1994: 46) assumes that a short monophthong takes on one mora (1a) and a long monophthong holds two moras

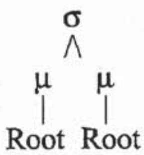
(2b) while a short diphthong is composed of two vowels connected to a light syllable through one mora (2c); an ordinary diphthong is composed of two vowels mediated by two moras (2d). Long monophthongs and diphthongs make up heavy syllables. Short monophthongs and short diphthongs are responsible for light syllables. Thus, we have the following four types of representation:

(2) Monophthongs



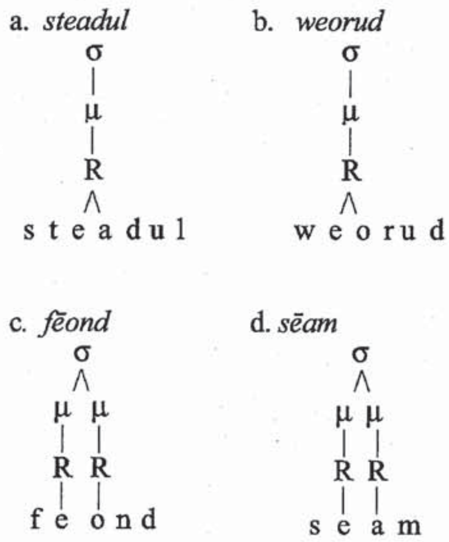
It is natural to expect, then, that a light syllable and a heavy syllable, whether they are monophthongs or diphthongs, to give rise to a heavy syllable and a superheavy syllable, respectively when followed by a consonant (cf. Hyman, 1985). Maintaining Lass's proposal, I further assume that each of the terminal segmental elements, expressed by either V or C, is an alias of a given Root node, in line with Selkirk's (1988) Two-Root Theory. Thus, the structure in (3) is posited for heavy VV and CV syllables:

(3)



The diphthongal parts of *steadul* 'foundation', *weorud* 'army', *feond* 'fiend', *seam* 'seam', for example, are given the following prosodic structures, respectively:

(4)



In (4a, b) the diphthongs are short and therefore correspond to one mora, while those in (4c, d) are linked to two moras, indicating an important difference in syllable weight.

2.2 Back Mutation

The term Back Mutation usually refers to a diachronic process in which a short monophthong turns into a short diphthong by means of insertion of / ə /,[1] triggered by a [+back] vowel in the immediately following syllable. Dresher (1978), directing his attention to the constituency of the verbal paradigm, proposes a synchronic grammar of OE Mercian dialect in which short monophthongs turn into their diphthongal counterparts by the rule of Back Mutation. Let us take a look at the examples in (5).

(5)

	a. *man*	b. *gate*	c. *valley*
Sing			
Nom.	wer	get	
Acc.	wer		dene
Gen.	weres		
Dat.	were	gete	dene
Pl.			
Nom.	weoras	geatu	dene
Acc.		geatu	
Gen.		geata	
Dat.	weorum	geatum	deanum

(Dresher, 1978: 22)

The stems of these three words are /wer/, /get/, and /den/, respectively. They are diphthongized when followed by a suffix that contains a back vowel, as evidenced by *weoras, geatu, deanum*; they never show up as **weras*, **getu*, **denum*. The rule Dresher (1978: 22) puts forward in the SPE style standard theory is given in (6).

(6) Back Mutation

$$\phi \rightarrow \mathrm{ə} \;/\; \begin{bmatrix} +\text{syll} \\ -\text{back} \\ -\text{long} \\ +\text{stress} \end{bmatrix} \;\_\_\_\_\; [-\text{syll}] \begin{bmatrix} +\text{syll} \\ +\text{back} \end{bmatrix}$$

(7)

	cweoðu 'say' pres. ind. 1sing.	*cweðe* 'say' pres. subj. sing.
Underlying	/cweð+u/	/cweð+e/
Back Mutation	cweoð+u	d.n.a.
Surface	[cweoðu]	[cweðe]

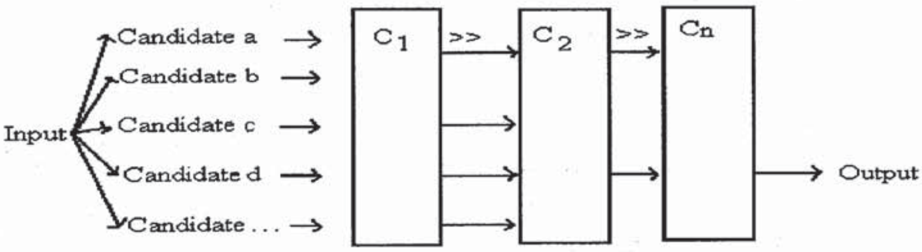
However, it is obvious that this rule satisfies only descriptive adequacy. What is crucial is the fact that the feature [+back] is shared by the triggering consonant and the latter half of the short diphthong in the preceding syllable. There is no doubt that even though the proposed rule may be descriptively adequate, nothing motivates why the environment in question needs to be filled up with a [+back] schwa-like vowel. On the other hand, OT, which premises that the grammar of a language consists of a hierarchically ranked set of universal constraints, seems capable of addressing a better explanation for BM.

What draws our attention is the difference in the shape of each syllable in the existent and non-existent forms. For example, the final consonant /r/ of *wer-* is syllabified as the onset of the second syllable when the stem takes on the nom. pl. inflectional suffix *-as*. This process, of course, would leave the first syllable codaless, i.e., an open syllable, unless anything additional is involved, as the non-occurring form **weras* indicates. The analysis to follow will demonstrate that it is possible to elicit the mechanism that invites such a combination of vowel insertion and harmony by appealing to joint work of simple constraints.

3. Optimality Theory

This section provides some basic ideas of the grammatical architecture of OT. OT advocates that surface actual representation, i.e., the optimal output for some input representation is determined by selecting among the possible candidates that the generator (GEN) parses and produces, by means of a set of universal constraints (CON). Prince and Smolensky (1993) holds most of those constraints to be violable. They are assorted into two types: faithfulness constraints and markedness constraints. Faithfulness constraints force identity relations between input and output while markedness constraints check on the discrepancies between those two levels. The process that determines the optimal output among possible candidates is worked out by checking whether or not each of the constraints is violated.[2] The notion of derivation, i.e., the serial, rule-based format allowing for intermediate levels of representation sandwiched between the input and the output is therefore no longer retained. OT asserts that evaluation of constraint violation is completed all at once, i.e., in a parallel mode. Kager (1999 : 8) gives a general picture of the OT grammatical architecture :

(8) Mapping of input to output in OT grammar



($C_1 >> C_2, >> \ldots C_n$ = constraint hierarchy)

4 . Analysis

4 . 1 Back Mutation

As we have seen in 2.2, the effect of Back Mutation consists of two parts : vowel insertion and assimilation. Let us start the analysis by examining the former process first.

OE reveals quite a consistent pattern as to where to place a word stress. Typically it attracts a main stress on the first syllable of a word, except for certain forms such as those beginning with a negative derivational prefix *un-*. This implies that disyllabic words in OE have a trochaic (Strong-Weak) rhythmic pattern. As a means of capturing the relationship between a given foot structure and its constituents, I propose the following constraint :

(9) PROMTROC : In a trochaic foot, the first syllable must be structurally more prominent than the second syllable in terms of its attributes: sonority, syllable weight, etc.

This constraint may be decomposed into smaller units such as PROMTROC/Sonority and PROMTROC/ WEIGHT, according to the attribute or domain for which it is relevant. Thus, PROMTROC permits not only *weres, gete* and *dene* but also *weoras, weorum, geata, geatum* and *deanum* while disallowing **weras, *werum, *geta, *getum* and **denum,* as their antepenult vowels are less sonorous than those in the penult position. For example, dat. pl. /geat+um/ is evaluated in Tableau (10).

(10)

get+um	PROMTROC
getum	*!
⇒geatum	√

Obviously this is not enough, however, because we have not taken into account the issue on syllable weight. In fact, PROMTROC does not serve to select the optimal candidates :

(11)

H H /|\ /\ RRR RR | | | | | g e t + u m	PROMTROC
a. L H / | /|\ RR RRR | | | | | g e t u m	*!
b.⇒ L H /\ /|\ RR RRR | /\ | | | gea tum	√
c.⇒ H H /|\ /|\ RRR RRR | | | | | | gea tum	√

Also, a wrong prediction would be made even if we took advantage of the individualized PROMTROC constraint. In (12), the candidate with a heavy syllable in the initial syllable is incorrectly judged as optimal ,i.e. (12c).

(12)

<table>
<tr><td>H H
/ | \ /\
RRR RR
| | | | |
g e t + u m</td><td>PROMTROC/TYSONORI</td><td>PROMTROC/WEIGHT</td></tr>
<tr><td>a. L H
/| /|\
R R R R R
| | | | |
g e t u m</td><td>*!</td><td>*</td></tr>
<tr><td>b.⇐ L H
/| /|\
R R R R R
| /\ | | |
g ea t u m</td><td>√</td><td>*!</td></tr>
<tr><td>c.⇒ H H
/|\ /|\
RRR RRR
| | | | | |
g e a t u m</td><td>√</td><td>√</td></tr>
</table>

Thus, this type of vowel epenthesis, in which no additional syllable weight is introduced, cannot be explained by only looking at the surface representations of possible candidates. It seems that the task can be accomplished by scrutinizing the relation between input the and the output. Under the rubric of Correspondence Theory,[3] McCarthy (1995a:370-72) proposes the following constraints to capture some input-output relations.

(13) Constraints on Correspondent Elements

a. MAX
Every element of S_1 has a correspondent in S_2.

b. DEP
Every element of S_2 has a correspondent in S_1.

c. IDENT(F)
Correspondent segments have identical values for the feature F.
If $x\Re y$ and x is [γF], then y is [γF].

d. CONTIGUITY
i. I-CONTIG ('No Skipping')
The portion of S_1 standing in correspondence forms a contiguous string.
Domain($\Re$) is a single contiguous string in S_1.

ii. O-CONTIG ('No Intrusion')
The portion of S_2 standing in correspondence forms a contiguous string.
Range($\Re$) is a single contiguous string in S_2.

e. {RIGHT, LEFT}-ANCHOR(S_1, S_2)
Any element at the designated periphery of S_1 has a correspondent at the designated periphery of S_2.
Let *Edge*(X, {L, R}) = the element standing at the Edge = L, R of X.
RIGHT-ANCHOR. IF x=Edge(S_1, R) and y=Edge(S_2, R) then $x\Re y$.
LEFT-ANCHOR. Likewise, *mutatis mutandis*.

f. LINEARITY — 'No Metathesis'
S_1 is consistent with the precedence structure of S_2, and vice versa.
Let x, y$\in$S1 and x', y'$\in$S2.
If $x\Re x'$ and $y\Re y'$, then
$x < y$ iff $\neg$ ($y' < x'$).

g. UNIFORMITY — "No Coalescencce"
No element of S_2 has multiple correspondents in S_1.
For x, y $\in$ S_1 and z $\in$ S_2, if $x\Re z$ and $y\Re z$, then x=y.

h. INTEGRITY — "No Breaking"
No element of S_1 has multiple correspondents in S_2.
For x $\in$ S_1 and w, z $\in$ S_2, if $x\Re w$ and $x\Re z$, then w=z.

First, let us start with the constraint hierarchy in (14).

(14) PROMTROCH >> DEP-ROOT, MAX-ROOT, IDENT (back) >> DEP-SEG

DEP-ROOT is a faithfulness constraint that requires every Root node in the output to have its correspondent. DEP-ROOT bans insertion of a Root node ; DEP-SEG prohibits epenthesis of a vowel or a consonant. IDENT (back) demands that the value of the feature [back] be identical between two corresponding segments. MAX-ROOT checks whether every Root node in an input is taken over to its output candidates.

Next, the quality/coloring of epenthetic vowels seems to be captured by the following partial order between IDENT (back) and a markedness constraint that demands that Root nodes share the same value for backness.[4]

(15) AGREE (back) : Root nodes agree in backness.

To avoid [-back] vowels in the input from turning into [+back] vowels, it seems necessary to give the following ranking :

(16) IDENT (back) >> AGREE (back)

Mounting AGREE (back) on the hierarchy in (14) gives the schema (17).

(17) PROMTROCH >> DEP-ROOT, MAX-ROOT >> IDENT (back) >> DEP-SEG, AGREE (back)

Tableau (18) shows that the proposed set of constraints winnows the second candidate out as the optimal output for the input /get+um/ :

(18)

Input: H H /|\ |\ RRR RR | | | | | g et + u m | [+back]	PROM TROCH	DEP-ROOT	MAX-ROOT	IDENT (back)	DEP-SEG	AGREE (back)
a. L H /\ / | \ R R R R R | | | | | g e t u m | [+back]	*!	√	√	√	√	*
b.⇒L H /\ /|\ R R R R R | /\ | | | g e a t u m \ / [+back]	√	√	√	√	*	*
c. H H / | \ /|\ R R R R R R | | | | | | g e a t u m \ / [+back]	√	*!	√	√	*	*
d. L H /\ /|\ R R R R R | /\ | | | g e i t u m | [+back]	√	√	√	√	*	*!*

The most faithful candidate (18a) violates the top ranking constraint PROMTROCH and is therefore excluded outright. The third candidate (18c), which shoulders a new Root node supplied by GEN is on a bad wicket against DEP-ROOT.

Next, Tableau (19) shows how the candidates for the input /wer+es/ are evaluated on the same constraint hierarchy.

(19)

H H / | \ /\ RRR R R | | | | | w e r+e s	PROM TROC	DEP-ROOT	MAX-ROOT	IDENT (back)	DEP-SEG	AGREE (back)
a. ⇒ L H /\ /|\ RRRRR | | | | | w e r e s	√	√	√	√	√	√
b. L H /|\ /|\ R R RRR | /\ | | | weo r e s | [+back]	√	√	√	√	*!	**
c. H H /|\ /|\ RRR RRR | | | | | | w e o r e s | [+back]	√	*!	√	√	*	**
d. L H /\ /|\ RR RRR | | | | | w o r o s \ / [+back]	√	√	√	**!	√	√

The first candidate (19a) shows the greatest faithfulness to the input, as it has not undergone any kind of construal process; in fact, it is exactly the same as the input itself except for the weight of its initial syllable. The second candidate (19b) loses because of its violation against Agree (back) due to the insertion of /o/. The third candidate (19c) violates Dep-Root ; therefore, it is worse than (19b). The candidate in (19d), the initial vowel of which has been replaced by a back vowel, militates against Dep-Seg.

When the input is /wer+as/, on the other hand, the optimal output is expected to be the candidate with a non-moraic epenthetic vowel with the feature value [+back]. The correct result is obtained with the same constraint set, as Tableau (20) illustrates :

(20)

H H /|\ /\ RRR RR | | | | | w e r+a s | [+back]	Prom Troc	Dep-Root	Max-Root	Ident (back)	Dep-Seg	Agree (back)
a. L H /\ /|\ R R R R R | | | | | w e r a s | [+back]	*!	√	√	√	√	*
b.⇒ L H /\ /|\ R R R R R | /\ | | | w eo r a s \ / [+back]	√	√	√	√	*	*
c. H H /|\ /|\ RRR RRR | | | | | | w e o r a s \ / [+back]	√	*!	√	√	*	*
d. L H /\ /|\ RR RRR | | | | | w o r a s \ / [+back]	√	√	√	*!	√	√

The candidate in (20a) is completely faithful to the input but it goes against PROMTROC. The second candidate has taken on a non-moraic vowel to satisfy PROMTROC, leaving a violation of DEP-SEG. The candidate in (20c) with an epenthesized moraic back vowel also fails to win due to a violation of DEP-ROOT, although the vowel satisfies AGREE (back). The fourth candidate cannot survive because it violates IDENT (back), which is ranked higher than AGREE (back). Therefore, we are left with the candidate in (20b) as the optimal winner.

4.2 Exceptions to Back Mutation

In this section, we consider some cases in which the effect of Back Mutation becomes void. According to Dresher (1978: 23), there are three types of exceptional cases:

(21)

a. long vowels: *nīðas* 'wickedness' pl., acc., *scēpa* 'sheep' pl. gen.

b. back vowels: *noman* 'name' sg. acc., *cunan* 'come'

c. when more than one consonant intervenes between the two vowels mentioned in the rule: *hwelpas* 'whelp' pl. nom. *greftas* 'idol' pl. acc.

I will show that these exceptional cases can also be accounted for by the same set of constraints. Note that what all three types above have in common is their stronger prominence on the initial syllable in terms of PROMTROC. The examples in (21a) and (21b) show that their initial syllables are heavy, and the first syllables of *noman* and *cunan* in (21b) seem to present no smaller prominence. Thus, Tableau (22) is counted upon to select [nīðdas] as the winner.

(22)

nīð+as	PROMTROC	DEP-ROOT	MAX-ROOT	IDENT (back)	DEP-SEG	AGREE (back)
a. ⇒ nīðas	√	√	√	√	√	*
b. nīaðas	√	*!	√	√	*	*

Next, let us move on to the case (21b). Tableau (23) shows the evaluation of three output candidates for the input *noman*.

(23)

nom+an	PROMTROC	DEP-ROOT	MAX-ROOT	IDENT (back)	DEP-SEG	AGREE (back)
a. ⇒ noman	√	√	√	√	√	√
b. noaman	√	*!	√	√	*	√
c. neaman	√	*!	√	*	*	*

Finally, let us see how Tableau (24) finalizes the optimal output for *hwelpas,* where a cluster of two consonants intervenes between the two vowels. Its first syllable makes up a heavy syllable, thus satisfying the top-ranking PROMTROC.

(24)

hwelp+as	PROMTROC	DEP-ROOT	MAX-ROOT	IDENT (back)	DEP-SEG	AGREE (back)
a. ⇒ hwelpas	√	√	√	√	√	*
b. hweolpas	√	*!	√	*	*	*
c. hwolpas	√	√	√	*!	√	√

Though the candidate (24c) is better than (24b) in that it obeys DEP-ROOT, which is ranked higher than IDENT (back), it cannot beat the unmarred candidate *hwelpas.*

4.3 Strong Cluster Reduction

There are some problematic cases that call for a further explanation. In this section I will be concerned with Strong Cluster Reduction (SCR).[5] It is a process that reduces an unstressed vowel to /e/ before a consonant cluster. The examples in (25a) show SCR's striking effect on the vowels of the unstressed penultimate syllables.

Notice that despite the fact that there is no back vowel in either of the present participle forms in (25a), Back Mutation seems to have been activated. On the contrary, the underlined diphthongs in (25b) stand in the right environment for Back Mutation. Dresher remarks that "the participle can be analysed as being made out of the infinitive by adding *-d-* and by changing *a* to *e*" (p. 26) and gives two reasons for that move.[6] To handle this kind of alternation, he proposes the rule of Strong Cluster Reduction in (26).[7]

(25)

a.	b.
cweoðende 'saying'	cweoðan 'to say'
spreocende 'speaking'	spreocan 'to speak'
eotende 'eating'	eotan 'to eat'
fortreodendes 'despising'	fortreodan 'to despise'
weofendan 'weaving'	weofan 'to weave'
wreocende 'avenging'	wreocan 'to avenge'

(26) Strong Cluster Reduction (SCR)

$$\begin{bmatrix} +\text{syll} \\ -\text{stress} \end{bmatrix} \longrightarrow \text{e} \;\_\_\_\_\; [-\text{syll}]\,[-\text{syll}]$$

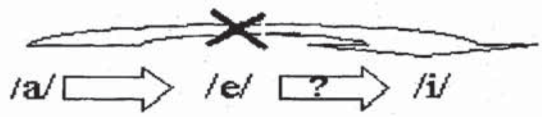
He suggests that this rule applies after Back Mutation, as the following derivation shows:

(27)

Underlying	/wer+as/	/cweð+an+de/
Back Mutation[8]	weəras	cweəð+an+de
SCR	d.n.a.	cweð+en+de
Surface	weəras	cweəðende
Orthography	*weoras*	*cweoðende*

What we need to capture from the standpoint of parallelism in OT is the driving force for SCR's reduction of the unstressed vowel in the penultimate syllable.[9] Note that /a/ never becomes /i/, although it is less sonorous than /e/ and therefore should be less marked in terms of sonority, as schematized in (28).

(28) Possible and Impossible shifts



What is the force that casts a damp over the unstressed /a/ in /cweðande/ into [i]? Comparing the numbers of operations performed on the relevant features on the /a/→/e/ scale and those on the /a/ →/i/ scale, we see that the latter alternation involves more steps than the former does, as the table in (29) indicates. And I suspect that this can be the counterbalance between relevant markedness constraints and faithfulness constraints.

(29)

Alternation	Input	Feature value(s) cancelled	Feature value(s) supplied	Total
/a/ → /e/	[+back, +low, -high]	[+back] [+low]	[-back] [-low]	4
/a/ → /i/	[+back, +low, -high]	[+back] [+low]	[-back] [-low] [+high]	5

Recall that all the words in (25a) present dactylic rhythm : σ́σ̌σ̌.[10] The medial syllable, which is the right element of a binary foot followed by an unfooted syllable in a prosodic word, is to undergo distressing. Using DACT-SYL as a mnemonic for the targeted syllable in the environment in question, i.e., {(σσ)$_{\text{Foot}}$σ}$_{\text{PrWd}}$, I propose the following tentative constraint hierarchy :

(30)

VOWEL REDUCTION$_{\text{DACT-SYL}}$ (VOREDUC$_{\text{DACT-SYL}}$)

*{[-high]&[+low]}$_{\text{DACT-SYL}}$, *{[+high]&[low]}$_{\text{DACT-SYL}}$ >> *{[-high]&[-low]}$_{\text{DACT-SYL}}$

>> IDENT(back)$_{\text{DACT-SYL}}$, IDENT(high)$_{\text{DACT-SYL}}$

Table (31) shows how *cweəðende* beats the other output candidates for the input *cweðande* on the VOREDUC DACT-SYL constraints :

(31)

cweðande	*{[-high]& [+low]}DACT-SYL	*{[+high]& [-low]}DACT-SYL	*{[-high]& [-low]}DACT-SYL	IDENT(back) DACT-SYL	IDENT(high) DACT-SYL
cweəðande	*!	√	√	√	√
⇒cweəðende	√	√	*	*	*
cweəðinde	√	*!	√	*	*

Incorporating VoREDUC DACT-SYL into the entire constraint hierarchy built up in Section 3, I propose the constraint hierarchy in (32), where I assume VoREDUC DACT-SYL to be ranked over IDENT (back):

(32)

PROMTROCH >> DEP-ROOT, MAX-ROOT >> VOREDUC DACT-SYL >> IDENT(back)>> DEP-SEG, >> AGREE(back)

This constraint ranking successfully sifts out *weofendan* from the output candidates for the input /wef+an+dan/. In Tableau (33) is illustrated the evaluation of five competing candidates.

(33)

<table>
<tr><th>H H H
/|\ /\ /|\
RRR RR RRR
| | | | | | | |
w e f+a n+d a n
| |
[+back] [+back]</th><th>PROM TROC</th><th>DEP-ROOT</th><th>MAX-ROOT</th><th>VOREDUC $_{DACT-SYL}$</th><th>IDENT (back)</th><th>DEP-SEG</th><th>AGREE (back)</th></tr>
<tr><td>a. L H H
Λ / \ / \
RR RRR RRR
| | | | | | | |
w e f a n d a n
\ /
[+back]</td><td>*!</td><td>√</td><td>√</td><td>*</td><td>√</td><td>√</td><td>*</td></tr>
<tr><td>b. L H H
Λ /|\ /|\
R R RRR RRR
| Λ | | | | | |
w e o f a n d a n
\ | /
[+back]</td><td>√</td><td>√</td><td>√</td><td>*!</td><td>√</td><td>*</td><td>*</td></tr>
<tr><td>c. ⇒L H H
Λ /|\ /|\
R R RRRRRR
| Λ | | | | | |
w e o f e n d a n
\ ¦ /
[+back]</td><td>√</td><td>√</td><td>√</td><td>√</td><td>*</td><td>*</td><td>* *</td></tr>
<tr><td>d. H H H
/|\ /|\ /|\
RRR RRR RRR
| | | | | | | | |
w e o f e n d a n
\ ¦ /
[+back]</td><td>√</td><td>*!</td><td>√</td><td>√</td><td>*</td><td>*</td><td>* *</td></tr>
<tr><td>e. L H H
Λ /|\ /|\
R R RRR RRR
| Λ | | | | | |
w e o f i n d a n
\ ¦ /
[+back]</td><td>√</td><td>√</td><td>√</td><td>*!</td><td>*</td><td>*</td><td>* *</td></tr>
</table>

5. Concluding Remarks

In this article I have argued that Back Mutation in OE can be explained as a result of interaction among hierarchically ordered constraints. It was shown that the epenthetic effect of Back Mutation springs out, solicited by a high ranking markedness constraint that disfavors any discrepancy between the rhythmic structure of an input form and its prominence; the assimilation of the epenthetic vowels is brought forth by AGREE (back). I also examined Strong Cluster Reduction, a problematic case to the present OT treatment of Back Mutation, and presented a tentative analysis to obtain SCR's effect from another set of constraints built in the same hierarchy.

Notes

1. As regards the phonetic quality of the inserted element, Brunner (1953) holds it to be merely schwa interpreted as [eə] for eo, and [æə] for ea, whereas Lass and Anderson (1975) view these diphthongs literally as [eo] and [æa], with the second element agreeing in height with the first vowel. Dresher (1978) also assumes the diphthongal [ə] to have the feature [+back].
2. The constraints are hypothesized to be omnipresent in natural languages, i.e., they are universal. Thus, what produces between-language as well as in-language variation depends on how those constraints are knit up in each individual language.
3. McCarthy (1995) defines the notion of correspondence as follows: Correspondence
   Given two strings S_1 and S_2, **correspondence** is a relation R from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ are referred to as **correspondents** of one another when $\alpha \in \beta$
4. Cf. Borowsky's (2000: 2-3) AGREE constraint in her analysis of voicing assimilation in Dutch and English.
5. I will leave Dresher's (1978) proposed rules of Palatalization, a-raising, and Smoothing for future research.
6. See Dresher (1978: 28-29).
7. Dresher himself admits that "this analysis might appear to some to be unnecessarily 'abstract', as it involves positing an underlying back vowel which never appears on the surface in the participle." (p. 25)
8. "Back Mutation does not apply in the paradigm of *deg*. . . . As the plural form of *deg* meet the environment for Back Mutation, we would expect **deagas*, **deaga, and* **deagum*. However, Back Mutation is often blocked before the back consonants *g, c, h* (phonetically [g], [k], and [x], respectively)." (Dresher, 1978: 29-30)
9. It might be argued that the vowel in question is a schwa, as we can find in Present-day English at

an unstressed position.

10. This type of structure is established by the following two constraints:

i. a. FT-BIN: Feet are binary under moraic or syllabic analysis. (Kager, 1999: 161)

b. ALIGN (Ft, Left, PrWd, Left): Every foot stands at the left edge of the prosodic word.

(Kager, 1999: 163)

In ii are represented the foot structures for *eotende* and *weofendan*:

```
ii. a.  σ    σ      σ          b.  σ    σ     σ
        |   /|\    /\              /\  /|\   /|\
      {(e  t a n) Ft d e}PrWd    {(we  fan) Ft dan}PrWd
```

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