An Optimality Account of Stress and High Vowel Deletion in Old English*

Chang Yong Sohn

1. Introduction

It has long been argued that Old English (OE) High Vowel Deletion (HVD) is sensitive to foot structure and various attempts have been made to explicate the correlation (Kiparsky & O'Neil 1976, Keyser & O'Neil 1985, Kaminashi 1989, Riad 1990 and Dresher & Lahiri 1991, etc.). This paper presents an analysis of OE stress and HVD within the framework of Optimality Theory as recently developed by McCarthy & Prince (1993a, b) and Prince & Smolensky (1993). I argue that the augmented trochee such as proposed by Dresher & Lahiri (1991) must be replaced by the bimoraic trochee, whose status has been massively supported by recent work on various quantity-sensitive trochaic patterns (McCarthy & Prince 1986, Hayes 1987, 1991, Prince 1991 and Mester 1992). This replacement for the better would be inconceivable without some mechanism allowing for incoherence and coherence in a principled way. As a soft non-declarative constraint-based theory, Optimality Theory readily offers such a mechanism for formalizing the ambivalent nature of the OE foot. Optimality Theory as the basis of the present analysis is argued to be a theory that can do away with some redundancies of rule-based metrical theories. It is also demonstrated that by positing the bimoraic trochee as the OE foot there emerges a much simpler account of HVD.

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2. High Vowel Deletion

Based on the traditional description by Campbell (1959), the context for HVD can be summarized as in (1):

(1) High Vowel Deletion (Campbell 1959 § 345)

High vowels are deleted after a heavy syllable, or a light stressed syllable followed by another syllable. They remain after a light stressed syllable, or a heavy syllable followed by a light syllable.

For the sake of explicitness, I schematize the constexts for deletion and retention in (2):[1]

(2) Deletion and Retention Contexts

Deletion	Retention
a. H__	d. Ĺ__
b. Ĺ L__	e. HL__
c. Ĺ H__	

Representative forms are exemplified in (3):

(3) Examples

a. lād+u	lād	ō–Stem Fem. Nom. Sg.	'way'
b. bisen+u	bisen	ō–Stem Fem. Nom. Sg.	'example'
c. we(o)ruld+u	we(o)ruld	i–Stem Nom. Sg.	'world'
d. rac+u	racu	ō–Stem Fem. Nom. Sg.	'rake'
e. lenden+u	lendenu	a–Stem Neut. Nom./Acc. Pl.	'loins'

It seems obvious that a metrical constituency higher than the syllable is to be invoked to make the context of deletion and retention sound more plausible. A simple listing of the contexts such as given in (2) does not shed light on why HVD does and does not occur in those particular environments. A metrical constituency of foot enables us to capture that equivalence easily and simplify the rule accordingly. No previous analyses view HVD as anything other than a foot–related phenomenon. They only differ in what type of foot is involved.

[1] L and H represent a light and a heavy syllable, respectively.

3. Previous Analyses

Two major previous approaches (Keyser & O'Neil 1985 and Dresher & Lahiri 1991) diverge regarding the foot type to be employed and how to characterize the vowel to be deleted.[2]

Let us briefly go over how each analysis accounts for HVD. In (4) and (5), the rules of foot formation and HVD in the two analyses are given:

(4) Foot Formation

a. Keyser & O'Neil (1985: 6)
Gather rimes from left to right into binary quantity-sensitive, *right-headed* trees.

b. Dresher & Lahiri (1991: 255)
From left to right, build binary, quantity-sensitive left-headed trees whose left branch contains *at least two* moras.

(5) High Vowel Deletion

a. Keyser & O'Neil (1985: 10)

$$\begin{array}{c} \mathrm{V} \\ | \\ [+\mathrm{high}] \end{array} \longrightarrow \phi \;/\; \mathrm{F}\; [\; \begin{array}{c} \mathrm{R} \\ | \\ \underline{\qquad} \end{array} \;]$$

b. Dresher & Lahiri (1991: 255)

$$\begin{array}{c} \mathrm{V} \\ | \\ [+\mathrm{high}] \end{array} \longrightarrow \phi \;/\; \begin{array}{cc} \mathrm{F} & \\ & \diagdown \\ & \mathrm{W} \\ & | \\ & [\;\underline{\qquad}\;] \end{array}$$

[2] Aside from some minor differences, Kiparsky & O'Neil (1976) proposed a segmental analysis quite similar in essential respects to that of Keyser & O'Neil (1985). Kaminashi (1989) utilized the foot type identical with that of Dresher & Lahiri (1991) in a more elaborate fashion. A more recent analysis of Riad (1990) clearly overcomes the problems of previous approaches mentioned here but it focuses on the diachronic aspect of HVD within the whole picture of quantitative change in the Germanic languages and, thus, makes different assumptions about the underlying forms of the relevant cases.

The foot type and the characterization of the deleted vowel, along with the most serious problem pertinent to each approach are summarized in (6):

(6) Previous Analyses

	Keyser & O'Neil	Dresher & Lahiri
Foot Type	Iamb	Augmented Trochee
Deletion	Deletion	Weak Deletion
Problem	Metrical Incoherence	Unattested Trochee

Keyser & O'Neil's iambic foot is not only unique to HVD but it is also incompatible with the general nature of OE stress. Thus, their analysis requires another, distinct trochaic foot for the OE stress pattern. On the other hand, Dresher & Lahiri's augmented trochee is in perfect harmony with the predominance of the initial syllable in OE.[3, 4] However, the metrical coherence here is achieved only by means of the introduction of the new foot type Augmented Trochee unattested in the trochaic system in general.[5] The notion of metrical coherence as couched in Dresher & Lahiri denotes the status of a system where a single metrical pattern but not multiple patterns persists across derivations and is available to a number of different processes.[6] But they do not say anything about metrical coherence in the pattern itself and implicitly assume that the pattern, if there is one, is always metrically coherent in such a way that it can be derived from a noble foot whose status can never be challenged. As will be clear from the

[3] Clearly, this involves an ample simplification of the various aspects of OE stress, especially that of the prefixed words.

[4] Dresher & Lahiri also take Sievers' Law in Gothic as a case supporting their augmented trochee. Recent analyses (Riad 1992 and Calabrese 1993) deny its direct relevance to foot structure and view it as a result of various operations germane to syllabification.

[5] For other potential problems with the augmented trochee, refer to Riad (1990) and Sohn (1991).

[6] What metrical coherence in this sense aims at is to invoke a single metrical pattern per language. It goes without saying that a metrically coherent system is easier to learn and to parse. However, a fundamental question remains to be answered as to how much we can adhere to metrical coherence; can all languages always be described without appealing to some *rule-specific* or *level-specific* metrical structures?

later discussion of OE stress, I fully agree with them regarding the superiority of a metrically coherent *system* but disagree as to how metrical coherence can and should be expanded to the *pattern* itself. Upon relaxing the necessity of metrical coherence onto a pattern, the OE stress pattern and the HVD can readily be viewed as involving the bimoraic trochee whose possible expansions include two light syllables or a heavy syllable and exclude categorically anything smaller or larger than the two-mora size.[7] Although its actual manifestation in foot parsing seems almost invariant and pervasive, the bimoracity of the Old English foot is not always maintained and appears to be disrupted under some specific circumstances. This 'except when' caveat clearly suggests the appropriateness of Optimality Theory in which violation of constraints is anticipated and well accommodated.

4. Old English Stress

Before going into how the OE stress pattern can be analyzed within the framework of Optimality Theory, let us briefly mention some general properties of Optimality Theory, which are relevant to the present analysis.

(7) Optimality Theory (McCarthy & Prince 1993ab, Prince & Smolensky 1993)

a. Constraints are *violable*.
b. There is a *universal inventory* of constraints (possibly with language-specific variants).
c. Constraints are ranked on a *language-specific* basis. The optimal candidate (minimal violation) is the one which satisfies the highest-ranked constraint. In case of a tie (if there is more than one candidate which satisfies the constraint, or none), the next-highest ranked constraint decides, and so on.
d. There are no rules and no serial derivation, hence no intermediate levels. All possible analyses of an underlying form are candidates for evaluation.

A crucial property of Optimality Theory is the idea that well-formedness

[7] Put more explicitly, the *strictly* bimoraic trochee dismisses (L) and (HL) as illegitimate feet.

constraints can be violated minimally under specific conditions that compel violation. In principle, any constraint can be violated if a superordinate constraint forces violation and the violation should be minimal.

In addition to a host of faithfulness constraints regulating the distance from the input and output forms, a family of well-formedness constraints called Generalized Alignment is extensively proposed by McCarthy & Prince (1993a). It is argued to encompass hitherto unrelated phenomena such as directionality of foot-parsing, cyclicity, and extrametricality and plays a pervasive role in Optimality Theory. Its definition is given in (8):

(8) Generalized Alignment (McCarthy & Prince 1993a: 2)

ALIGN (Cat1, Edge1, Cat2, Edge2) $=_{def}$

$\forall$Cat1 $\exists$Cat2 such that Edge1 of Cat1 and Edge 2 of Cat2 coincide.

Where

Cat1, Cat2 $\in$ PCat $\cup$ GCat

Edge1, Edge2 $\in$ {Right, Left}

A Generalized Alignment constraint requires that a designated edge of each prosodic or grammatical constituent Cat1 coincide with a designated edge of some prosodic or grammatical constituent Cat2. Notice that there is a crucial asymmetry in the definition of Generalized alignment; universal quantification over the first constituent argument and existential quantification over the second.

Optimality Theory does not allow a procedural account of directionality of foot parsing since it is a theory of constraints on the well-formedness of representations rather than a theory of rules or procedures building representations. Thus, as a constraint-based theory, it must encode directionality in different ways.[8] In McCarthy & Prince (1993a), directionality of foot-parsing emerges from the interaction between a faithful constraint PARSE-Syll and an alignment constraint ALIGN (Ft, L/R, PrWd, L/R). In addition, as a quantity-sensitive system, OE requires an additional constraint FOOT BINARITY. The definition of these three constraints and the

[8] In the same vein, Free Element Condition (Prince 1985), whose definition presupposes procedural iterative operation, needs to be encoded in such a way to fit in a constraint-based account. Its constraint-version will be proposed later in this section.

ranking among them are given in (9). PARSE-Syll demands that every syllable must be parsed by a foot and it forces iteration. FOOT BINARITY requires a bimoraic constituent and each mora of a foot that exceeds or falls short of two moras incurs a violation.[9] ALIGN (Ft, L, PrWd, L) constraint demands the perfect alignment of the left edge of every foot with that of a prosodic word and it urges every foot to be located as near as possible to the left edge of a prosodic word.[10]

(9) Left-to-Right Directionality

PARSE-Syll: Syllables must be parsed by feet. (Iteration)
FOOT-BINARITY (FTBIN): Feet must be binary at the moraic level. (Bimoraic Trochee)
ALIGN (Ft, L, PrWd, L) = A-Ft_L: The left boundary of every foot must be aligned with the left boundary of a prosodic word. (Directionality)

FTBIN $\gg$ PARSE-Syll $\gg$ A-Ft_L

Following the usual notational conventions, the optimal output among the candidate set is preceded by a right arrow in the constraint tableau given in (10). Constraints are placed in their domination order, violations are marked by * and fatal violations are indicated by !. Shading indicates the irrelevance of the constraint to the fate of the candidate. The prosodic word boundaries are represented by square brackets and the foot boundaries by parentheses.

[9] Note that this constraint as it stands regulates the size of a foot and does not concern the prominence relationship within a foot. For the latter, I assume an additional constraint FOOT FORM (Trochaic) or ALIGN (Ft, L, H/σ, L) demanding the alignment of the left boundaries of every foot and a head syllable. For this kind of a reductionist view on the foot types, see McCarthy & Prince (1986) and Prince (1991). The reductionist approach is in sharp contrast with the Hayesian approach where most of relevant information is directly encoded in the inventory of the foot types.

[10] An alignment constraint ALIGN (Ft, E, σ, E) is assumed to prohibit the dissecting of a foot into a heavy Syllable. As a constraint-based version of the Syllable Integrity Hypothesis (Prince 1983), it is undominated and so inviolable.

(10) Constraint Tableau 1

	Candidates	FTBIN	PARSE-Syll	A-Ft$_L$
1a	⇒ [(wero)du]		*	
b	[(wero)(du)]	*!		$\sigma\sigma$
c	(we(rodu)]		*	σ !
d	[(werodu)]	*!		
e	[(we)ro(du)]	*!*	*	$\sigma\sigma$
2a	⇒ [(hēa)fu(dum)]		*	$\sigma\sigma$
b	[(hēa)(fudum)]	*!		σ
c	[(hēa)fudum]		**!	
d	[hēafu(dum)]		**!	$\sigma\sigma$
e	[(hēafudum)]	*!**		
f	[(hēa)(fu)(dum)]	*!		$\sigma\sigma\sigma$
g	[(hēafu)(dum)]	*!		$\sigma\sigma$

The candidates **1b**, **d**, and **e** are eliminated since they contain one or more non-bimoraic feet, violating the top-ranked constraint FTBIN. Between remaining candidates, **1a** and **1c**, the alignment constraint A-Ft$_L$ plays a decisive role in choosing **1a** over **1c**. Notice here that the ranking of FTBIN dominating A-Ft$_L$ is crucial for selecting **2a** as the optimal output over **2e**. The reverse ranking would pick out **2e** as the optimal output since there is no unparsed syllable in addition to the perfect alignment of the left edges of the foot and the prosodic word.[11]

Next, let us turn to words beginning with a light-heavy sequence. As the primary stress always falls on the initial syllable of a prosodic word, the initial light syllable receives the primary stress and the immediately following heavy syllable is unstressed. Given the constraint hierarchy in (9), the optimal output would be [L(H)...] since FTBIN is the highest-ranked constraint and any candidate with an instance of a monomoraic or trimoraic foot will be ruled out as suboptimal.[12] This implies that the initial LH sequence forms a foot as a whole such as [(LH)...].[13]

[11] See Appendix for the verification of the particular constraint domination order given in (10).

[12] Note that the faithful constraint PARSE-Syll is ranked lower than FTBIN and unparsed syllables can be ignored to satisfy the higher-ranked constraint FTBIN. Also note that a bimoraic foot consisting of the initial light syllable and the first mora of the heavy syllable would be impossible without violating ALIGN (Ft, σ), which I assume inviolable.

At a glance the stress pattern of initial LH could be accounted for by ranking A–Ft$_L$ higher than FTBIN. As illustrated in (10), however, the reverse ranking is necessary and, thus, we need an additional constraint here. ALIGN (PrWd, L, Ft, L), which requires the alignment of the left edge of every prosodic word with the left edge of a foot, will do the job here.

(11) Constraint Tableau 2

	Candidates	A–PrWd$_L$	FTBIN	PARSE–Syll	A–Ft$_L$
a	⇒ [(færel)du]		*	*	
b	[(fæ)(rel)du]		*	*	σ!
c	[fæ(rel)du]	σ!		**	σ
d	[fæ(reldu)]	σ!	*	*	σ
e	[(færeldu)]		**!		
f	[(fæ)rel(du)]		**!	*	
g	[(fæ)reldu]		*	**!	σ

Of special interest in the constraint tableau 2 given in (11) is the contrast between the optimal candidate **a** and the suboptimal candidate **b**. As the constraint A–PrWd$_L$ only requires the perfect alignment of the left edge of a prosodic word with the left edge of a foot and does not care about the foot shape as a whole, two output candidates **a** and **b** cannot be chosen over each other until they pass down to the lowest ranked constraint A–Ft$_L$. A–Ft$_L$, whose original function is to derive left–to–right directionality, compels the selection of a trimoraic foot of **a** over a degenerate foot plus a bimoratic foot of **b**.

Two of the important properties frequently referred to as principles governing metrical structure construction fall naturally out of the alignment constraint ALIGN (Ft, L/R, PrWd, L/R).

(12) Maximality (Prince 1985: 471)

Feet are of maximal size.

[13] This is a clear case of well–documented top–down effects (Hulst 1984, Lahiri & Hulst 1988, Hanson & Kiparsky 1993), for which such a procedural account has been proposed that the End Rule Left applies prior to or simultaneously with foot formation ensuring the initial primary stress.

The principle can be reinterpreted without changing its theoretical implications in the following way:

(13) Minimize the number of feet.

As the alignment constraint takes *every* edge of a foot as a token for measuring the distance from a particular edge, it follows from the constraint that the fewer the foot edges that exist, the fewer the violations that are incurred. Thus, among two possible options which satisfy the highest-ranked ALIGN (PrWd, L, Ft, L), the one with a single foot [(LH)...] is taken as the optimal output over the sequence of two feet [(L)(H)...]. As long as the alignment constraint is operative, the output with the minimal number of feet will always be selected as optimal over those with an additional foot. A further extension of the alignment constraint allows us to obviate the need for the Free Element condition (FEC) explicitly proposed by Prince (1985).

(14) Free Element Condition (Prince 1985: 479)

Rules of primary metrical analysis apply only to Free Elements–those that do not stand in the metrical relationship being established; i.e., they are "structure–filling" only.

What FEC rules out in a rule–based system is a structure–changing application of iterative foot building. Suppose the left–to–right iterative quantity insensitive trochaic pattern for the following sequence:

(15) **a** [$(\sigma\sigma)(\sigma\sigma)$]
b [$(\sigma(\sigma(\sigma\sigma)))$]

What distinguishes **a** from **b** is whether the subsequent application of foot formation can peep into the existing constituency created by a prior application. FEC explicitly prohibits the structure–changing application in **b**, where a foot is formed partly on an already–bound syllable. In contrast, the second foot in **a** is formed on exclusively free syllables, in conformity with FEC. As is the case with directionality, FEC should be encoded differently in a constraint–based system like Optimality Theory adopted in this paper. The alignment constraint ALIGN (Ft, L, PrWd, L) independently needed for directionality can supersede FEC since the structure–changing mode of application in violation of FEC necessarily results in more foot boundaries than the structure–filling mode of application in accord with FEC does.

(16) Constraint Tableau 3

	Candidates	$A\text{–}Ft_L$
a	⇒ $[(\sigma\sigma)(\sigma\sigma)]$	**
b	$[(\sigma(\sigma(\sigma\sigma)))]$	***!

As illustrated in (16), the output **a** violates the $A\text{–}Ft_L$ one time less than the output **b**. and has more chance of being selected as optimal.[14]

Since the alignment constraint ALIGN (Ft, L/R, PrWd, L/R) quantifies universally over the edges of a foot, every designated edge of a foot should be taken into consideration for computing the distance from a designated edge of a prosodic word. Two ways are available to minimize the degree of violation.[15] First, violation can be minimized by stacking up every foot to the edge and directionality emerges from this way of minimizing the violation of the alignment constraint. Another way of minimizing the violation can be achieved by minimizing the number of feet which would serve as a token for measuring the violation. As shown above, Maximality and FEC are automatic consequences of another way of minimizing the violation of the alignment constraint.

In rule–based approaches of stress systems (Prince 1983, 1985, Hayes 1987, 1991), three things govern the mode of building metrical structure utilizing a limited inventory of foot types: Directionality, Maximality and FEC. The way they are encoded in the theory implies that they are independent. In Optimality Theory, however, all three things converge to a single alignment constraint. And what this convergence predicts is that when directionality is not required, neither are Maximality and FEC, and vice versa.

[14]From the discussion so far, it might be inferred the Maximality and FEC can be reduced to a single general constraint whose effect is to minimize the number of feet. As for Maximality, the reducibility is more obvious since it is a simple tautological rephrasing, but FEC, given its various versions and interpretations, appears to succumb less readily to the convergence.

[15]Here only iterative parsing is of our concern and PARSE–Syll is assumed to dominate the alignment constraint. Thus, the otherwise optimal output $[(\sigma\sigma)\sigma\sigma]$, where the fewest possible (one and only) foot is located as close as possible to the edge of the prosodic word, is out of competition because it violates the dominant constraint PARSE–Syll.

So far it has been shown that the OE stress pattern can be accounted for in terms of the bimoraic trochee. Crucial to our choice of Optimality Theory as the basis of the proposed analysis is the fact that all the constraints assumed to account for OE stress are independently motivated for the typological analysis of a variety of trochaic systems and no constraints peculiar to OE are needed.[16]

5. High Vowel Deletion

As mentioned earlier, HVD has been argued to be intimately connected with the foot structure and it is essential to recast its properties in terms of the bimoraic trochee. The representative forms are given in (17).

(17) Representative Forms

a. scip+u	scipu	a–Stem Neut. Nom./Acc.Pl.	'shops'
b. gād+u	gād	ō–Stem Fem. Nom. Sg.	'goad'
c. werod+u	werod	a–Stem Neut. Nom./Acc.Pl.	'troops'
d. hēafud+u	hēafudu	a–Stem Neut. Nom./Acc.Pl.	'heads'
e. fǣreld+u	fǣreld	a–Stem Neut. Nom./Acc.Pl.	'journey'
f. hlāford+u	hlāford	a–Stem Neut. Nom./Acc.Pl.	'lords'

Given the constraint hierarchy assumed for the stress pattern and assuming that HVD is a direct consequence of stray erasure, it is quite obvious that there is no deletion in the words consisting of even–parity light syllables or heavy syllables. This is because, in those words, the two dominating constraints A–PrWd$_L$ and FTBIN never conflict with the PARSE–Syll and every syllable in such words is parsed by a foot. Examples of this type are given in (18):

(18) No Deletion

A–PrWd$_L$≫FTBIN≫PARSE–Syll≫A–Ft$_L$

[(lufu)]	ō–Stem Neut. Nom. Sg.	'love'
[(wor)(dum)]	a–Stem Neut. Dat. Pl.	'word'
[(nī)(tenu)]	a–Stem Neut. Nom./Acc. Pl.	'animals'
[(hēa)(fudu)]	a–Stem Neut. Nom./Acc. Pl.	'heads'

[16] For motivations and interactions of the constraints mentioned so far, refer to McCarthy & Prince (1993a).

To account for HVD, we can employ the optimality-theoretic notion of deletion given in (19). In Optimality Theory, deletion is the output interpretation of unparsed material at the phonetic component.

(19) Deletion in Optimality Theory (Prince and Smolensky 1993: 24)

Unparsed elements are denied phonetic realization, in accord with the notion of stray erasure.

Since it depends crucially on the definition of parse whether an element is parsed or not, it is necessary to be more careful about the notion of parse. For the sake of comparison, let us take the stress pattern of Wankumara, which displays similar properties to that of OE except in one crucial respect.[17] As in OE, left-to-right directionality emerges from the following constraint hierarchy given in (20):

(20) Constraint Tableau 4: Wankumara (Hayes 1991: 167, McCarthy & Prince 1993a: 15)

	Candidates	PARSE-Syll	A-Ft$_L$
a	[(σσ)σσσ]	**!*	
b	⇒ [(σσ)(σσ)σ]	*	σσ
c	[(σσ)σ(σσ)]	*	σσσ!

As indicated by the surrounding prosodic word boundaries, syllables not incorporated into a foot are not deleted since they are parsed by a prosodic word. In other words, they are unparsed and parsed at the same time but in two different senses. Parsehood of an element varies depending on the category of its mother node. So the last three syllables in a are unparsed by a foot but they are parsed by the next higher category of the prosodic word. A finer distinction of PARSE is required to distinguish these two different cases of PARSE. Built on the conception of Weak Layer Hypothesis developed in Itô & Mester (1992), I propose that the faithful constraint PARSE be decomposed into two sub-constraints: one requiring strictly local parsing and the other allowing nonlocal parsing. Their definitions are

[17] Wankumara also differs from OE with respect to quantity-sensitivity, but the difference is not relevant to the point being made here.

given in (21).[18]

(21) Decomposition of PARSE

> PARSE^{l}–Cat_i: Cat_i is parsed iff it is associated with Cat_{i+l} .
> PARSE^{g}–Cat_i: Cat_i is parsed iff it is associated with Cat_{i+j} .$(1\leq j)$

Local parsing requires that a prosodic category be associated with the next higher prosodic category and general parsing demands a prosodic category to be associated with a higher prosodic category.

Keeping the two distinct notions of PARSE in mind, let us go back to HVD. Assuming the bimoraic trochee as the OE foot, HVD can be reinterpreted as the deletion of the head of unparsed syllables. Here the relevant syllables are unparsed with respect to two notions of PARSE defined in (21). Thus, the essential property of HVD is remarkably simple; to achieve a strictly layered prosodic structure throughout the whole domain of a prosodic word.[19]

(22) Observational Generalization of OE High Vowel Deletion

> The head of *unfooted* syllables is deleted. Here the optimization target is a *strictly layered* prosodic structure throughout the whole domain of a PrWd.

Then the question is what forces the general version of PARSE ineffective in OE as opposed to cases like Wankumara's where unfooted syllables are parsed by a prosodic word and become exempt from stray erasure.

As for apocope in which the head of the final syllable gets deleted, we need an additional alignment constraint given in (23), which requires the right edge of every PrWd to be aligned with the right edge of a foot. I assume the domination hierarchy given in (24) among the set of relevant constraints and the following chart shows that the output with the last syl-

[18] Although it is given in a very general form, the decomposition works more straightforwardly within the vertical domain from the syllable up to the prosodic word. For the subsyllabic level, PARSE must be refined in a more substantive way using notions like Mora Confinement (Itô & Mester 1992). The levels beyond the prosodic word do not appear to exhibit interesting cases of loose parsing.

[19] Due to the massive deletion of non–high vowels in open syllables (Dahl 1938, Campbell 1959, Hogg 1992) predating the OE period, non–highvowels rarely appear in the unparsed position.

lable unparsed even by the PrWd is taken to be optimal based on that constraint hierarchy. In the chart, elements which are not parsed by any higher prosodic categories are represented by surrounding angled brackets.

(23) Additional Alignment Constraint

ALIGN (PrWd, R, Ft, R)=A–PrWd$_R$: Align the right edge of every PrWd with the right edge of a foot.

(24) Constraint Tableau 5: Apocope

PARSE–Ft: Feet must be parsed by a PrWd

PARSE–Ft≫FTBIN≫PARSE^{l}–Syll≫A–Ft$_L$≫A–PrWd$_R$≫PARSE^{g}–Syll

		PARSE–Ft	FTBIN	PARSE^{l}–Syll	A–Ft$_L$	A–PrWd$_R$	PARSE^{g}–Syll
1a	⇒ [(wero)]<du>			*			*
b	[(wero)](du)	*!	*		σσ		
c	[(wero)du]			*		σ!	
d	[(werodu)]		*!				
2a	[(H)(LL)L]			*	σ	σ!	
b	[(H)L(LL)]			*	σσ!		
c	⇒ [(H)(LL)]<L>			*	σ		*
d	[(H)(LLL)]		*!		σ		

Both in OE and in Wankumara, two subspecies of PARSE are existent.[20] But in OE, being ranked so low and critically dominated by the alignment constraint A–PrWd$_R$, the more general PARSE^{g}–Syll is almost ignorable. By contrast, Wankumara has a different constraint hierarchy imposed on the same set of constraints, PARSE^{g}–Syll dominating the alignment constraint A–PrWd$_R$. In the constraint tableau 5, PARSE^{g}–Syll is ranked

[20] This is well in accord with a fundamental assertion of Optimality Theory that languages differ principally in the ranking they impose on constraints of a universal nature.

higher than A–PrWd$_R$ and the candidate in which the misalignment is overlooked to satisfy parsing is selected as the optimal output.

(25) Constraint Tableau 6: Wankumara

	Candidates	PARSE^l–Syll	PARSE^g–Syll	A–PrWd$_R$
a	⇒ [($\sigma\sigma$)($\sigma\sigma$)σ]	*		σ
b	[($\sigma\sigma$)($\sigma\sigma$)]σ	*	*!	

There is no need for an additional constraint to account for syncope. Syncope can be accounted for by the already existing constraint domination relation. This is illustrated in the tableau 7.

(26) Constraint Tableau 7: Syncope

PARSE^l–Syll≫A–Ft$_L$≫PARSE^g–Syll

	Candidates	PARSE^l–Syll	A–Ft$_L$	PARSE^g–Syll
a	[(hēa)fu(dum)]	*	$\sigma\sigma$!	
b	⇒ [(hēa)⟨fu⟩(dum)]	*	σ	*

There are a number of words that exhibit unexpected syncope. All of these words end with a non–high short vowel. In those cases, we can assume that the right edge has a special weight distribution such that non–high short vowels function as heavy along with quantitatively heavy sequences. So, at the right edge, the weight distinction is determined in terms of the quality of the vowel in addition to the quantity of the syllable.[21] As a result, another context for syncope is created if the final short vowel is non–high. (27) illustrates the positionally varying weight distinction and the relevant forms:

(27) Weight Distinction

	Nonfinal	Final
Heavy	VV, VC	VV, VC, V[–high]
Light	V	V[+high]

[21] A formal account of the special weight distribution may be given by resorting to the notion of mora catalexis proposed by Kiparsky (1992).

[(hēa)⟨fu⟩(de)]	a–Stem Neut. Dat. Sg.	'head'
[(hēa)⟨fu⟩(da)]	a–Stem Neut. Gen. Pl.	'head'
[(dē)⟨mi⟩(de)]	Past Indic. Sg. 1.3.	'judged'

The present analysis needs more refinement because it does not account for the fact that only the head of an unparsed syllable deletes and the remaining material survives. All the optimal output forms are those with the whole syllable including the onset consonant deleted. For instance, what we get from the constraint hierarchy assumed so far is *wero, hēadum,* and *færel,* etc., in which the onset consonant of the unparsed syllable also gets deleted. Another faithful constraint that regulates the degree of deviation between the input and output form is at work here. We can get the actual forms by adding the PARSE–Seg constraint to the lower end of the constraint hierarchy. This is illustrated in (28):

(28) Constraint Tableau 8

Candidates		...PARSE$^{\sigma}$–Syll	PARSE–Seg
1a	⇒ [(we)(rod)]⟨u⟩	*	*
b	[(we)(ro)]⟨du⟩	*	**!
2a	⇒ [(hēaf)⟨u⟩(dum)]		*
b	[(hēa)⟨fu⟩(dum)]		**!

To sum up, there is no need for a specific rule for HVD in the present analysis. Coupled with the alignment constraints, most of which are independently needed for the OE stress pattern, the bimoraicity enables us to simplify HVD as stray erasure. In addition, the lack of apheresis can be attributed to the topmost ranking of the constraint A–PrWd$_L$ in the overall constraint hierarchy.

6. Minimal Word

A more direct piece of evidence in favor of the bimoraic trochee comes from the word minimality constraint in OE. The fact that all lexical words in OE are minimally bimoraic cannot be easily accommodated in Dresher & Lahiri's augmented foot, which is minimally trimoraic.

7. Conclusion

In contrast with metrical coherence in the system, the OE stress pattern is not amenable to a metrically coherent analysis and an adamant foot is doomed to over- and under-generalization. Optimality Theory, in which constraint interactions are allowed, provides a natural way of abstracting away a "noble" foot from the apparently incoherent pattern. A well-motivated bimoraic trochee emerges as the OE foot, which loses its nobility in a tightly constrained way by interacting with two alignment constraints, which are in turn independently needed for a typological analysis of the trochaic systems. Besides, in our analysis in which the bimoraic trochee plays a central role, HVD can be viewed as a direct consequence of foot parsing, requiring no additonal processes.

8. Appendix

(29) Constraint Tableau 1

Candidates	FTBIN	PARSE-Syll	A-Ft$_L$
[(H)(L)(H)]	*!		***
⇒ [(H)L(H)]		*	**
[(H)(LH)]	*!		*
[(HL)(H)]	*!		**
[(HLH)]	*!**		
[(H)LH]		**!	

(30) Constraint Tableau 2

Candidates	FTBIN	A-Ft$_L$	PARSE-Syll
[(H)(L)(H)]	*!	***	
[(H)L(H)]		*!*	*
[(H)(LH)]	*!	*	
[(HL)(H)]	*!	**	
[(HLH)]	*!**		
⇒ [(H)LH]			**

(31) Constraint Tableau 3

Candidates	A–Ft$_L$	FTBIN	PARSE–Syll
[(H)(L)(H)]	*!**	*	
[(H)L(H)]	*!*		*
[(H)(LH)]	*!	*	
[(HL)(H)]	*!*	*	
[(HLH)]		*!**	
⇒ [(H)LH]			**

(32) Constraint Tableau 4

Candidates	PARSE–Syll	FTBIN	A–Ft$_L$
[(H)(L)(H)]		*	**!*
[(H)L(H)]	*!		**
⇒ [(H)(LH)]		*	*
[(HL)(H)]		*	**!
[(HLH)]		**!*	
[(H)LH]	*!*		

(33) Constraint Tableau 5

Candidates	A–Ft$_L$	PARSE–Syll	FTBIN
[(H)(L)(H)]	*!**		*
[(H)L(H)]	*!*	*!	
[(H)(LH)]	*!		*
[(HL)(H)]	*!*		*
⇒ [(HLH)]			***
[(H)LH]		*!*	

(34) Constraint Tableau 6

Candidatess	PARSE–Syll	A–Ft$_L$	FTBIN
[(H)(L)(H)]		*!**	*
[(H)L(H)]	*!	**	
[(H)(LH)]		*!	*
[(HL)(H)]		*!*	*
⇒ [(HLH)]			***
[(H)LH]	*!*		

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ABSTRACT

An Optimality Account of Stress and High Vowel Deletion in Old English

Chang Yong Sohn

Optimality Theory (McCarthy & Prince 1993a, 1993b Prince & Smolensky 1993) provides a very sound basis for explicating the intimate correlation between stress and High Vowel Deletion in Old English. In this paper, it is argued that three major principles in a rule-based metrical theory—Maximality, Directionality and Free Element Condition—can and should be collapsed into a single alignment constraint and that this reduction leads us to a redundancy-free system. It is also demonstrated that Optimality Theory, where the constraint conflict is readily anticipated, makes it possible to abstract away an invariant foot type—the bimoraic throchee—from the apparently variant stress pattern. Thus the metrical coherence is achieved here without appealing to such a peculiar foot as the augmented trochee (Dresher & Lahiri 1991). High Vowel Deletion is then analyzed as a direct consequence of parsing, requiring no additional process. The present analysis draws heavily on the assumption that the vertical locality must be relaxed to some degree and a way of incorporating non-local parsing is suggested.

Department of Linguistics
Building 100
Stanford University
Stanford, CA 94305
U. S. A.