Constraints on Homorganic Cluster Lengthening in Early English: A Unified Account of Vowel Lengthening and Shortening*

An-Nah Moon
(Inha University)

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Homoragnic Cluster Lengthening (HCL) has often been treated as exceptional or problematic in a holistic analysis of the quantitative changes of vowels in Middle English (ME). This paper aims to explore what constraints actively participate in HCL and to reconsider whether or not HCL is really incompatible with other quantitative changes of vowels, especially Pre-Cluster Shortening (PCS). This study starts with the assumption that the difference between HCL and PCS goes back to the different combination of the consonant clusters preceding a vowel. It is proposed that HCL is a consequence of the phonetic tendency that vowels and sonorants are longer before a voiced obstruent than before a voiceless one. The fact that only vowels are perceived as phonemically long in ME is captured by a conjoined constraint. Unlike previous analyses, it is shown that in an Optimality-theoretic analysis many causal factors are not mutually exclusive, but ranked with one another, and it is also demonstrated that HCL and the seemingly contradictory change, PCS, can be unified under the same hierarchy of constraint.

Key words: homorganic clusters, vowel lengthening, conjoined constraint, Pre-cluster shortening, early Middle English, late Old English, Optimality Theory

1. Introduction

Although phonemic vowel length was retained throughout ME as in OE,

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it became more and more predictable contextually due to a series of the quantitative changes that began to emerge in late Old English (OE). They paved the way for the ultimate loss of quantity distinctions between vowels and for the Great Vowel Shift (GVS) which caused drastic changes in vowel quality in stressed syllables in Early Modern English (Millward, 1989). The quantitative changes include two types of vowel lengthening, often called as Open Syllable Lengthening (OSL), and Homorganic Cluster Lengthening (HCL), and two types of vowel shortening, called Pre-Cluster Shortening (PCS), and Trisyllablic Shortening (TSS).

Many philologists and linguists have tried to show that these seemingly different changes in vowel quantity achieved the same goal, or were triggered by the one and same reason. However, HCL has almost always been treated as exceptional and/or problematic in their holistic analysis; Vowels before homorganic consonant clusters were lengthened (HCL), while vowels before nonhomorganic consonant clusters were shortened (PCS). Accordingly, how to incorporate HCL into a proposed motivation together with remaining quantitative changes of vowels in ME has been one of the controversial issues. This paper also aims to explicate what motivates HCL and whether HCL is really incompatible with other quantitative changes, especially with PCS, by investigating what constraints interact to account for the quantitative changes of vowels in ME.

This paper is organized as follows. In the following section, data of HCL are provided. In Section 3, previous analyses of HCL are briefly overviewed. In Section 4, phonetic studies on vowel length variation before consonant clusters are presented. Section 5 provides an Optimality-theoretic analysis of HCL. In this section, it is proposed that HCL is phonetically motivated, which is represented by and formulated into a conjoined constraint. The proposed analysis will show that the motivating factors mentioned in Section 3 may not be mutually exclusive, but interact with one another, and HCL and PCS are no longer contradictory and can be unified under the same hierarchy of constraints, with the help of basic tenets of Optimality Theory (OT). Section 6 concludes this paper.

2. Data

In late OE, short vowels began to be lengthened before the consonant

clusters such as /ld, mb, nd, ŋg, rd, rð/ and /rz/.[1] Since a liquid or nasal consonant after the target vowel is followed by a homorganic voiced consonant (usually obstruents), the vowel lengthening is often called as Homorganic Cluster Lengthening (HCL). The words given in (1) were assumed to have had long vowels in ME.[2]

(1) Homorganic Cluster Lengthening in late Old English[3]
a. /ld/ : gōld 'gold', cīld 'child', mīlde 'mild', fēld 'field'
b. /mb/ : cāmb 'comb', lāmb 'lamb', wāmb 'stomach', clīmb 'clime'
c. /nd/ : hānd 'hand', lānd 'land', bīnde 'bind', fīnd 'find'
d. /ŋg/ : lāng 'long', strāng 'strong', ʒūng 'young', sīngen 'sing'
e. /rd/ : bōrd 'board', fōrd 'ford', wōrd 'word', swōrd 'sword'
f. /rð/ : fūrþor 'further', ēorðe 'earth', wēorðe 'worth'
g. /rz/ : wȳrsa 'worse', ēarsas 'ears'
h. /rn/ : cōrn 'corn', bōūrnen 'burn', mūrnen 'mourn', fērn 'fern'
i. /rl/ : ērl 'earl', cērl 'churl'

However, vowels were not always lengthened before the homorganic clusters. When a third consonant directly followed the clusters as in (2a), and when they were in words with reduced sentence stress as in (2b), vowels were not lengthened.[4]

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1) There seems to be no consensus on the dating of HCL. Although the handbooks on ME cite HCL as contemporaneous with other quantity changes in ME, many scholars maintain HCL was the change of Old English, or late Old English (Mossé, 1952; Campbell, 1959; Brunner, 1963; Jordan, 1974).

2) Reconstruction of vowel length in the period is usually based spelling evidence, later length-sensitive changes and riming. *Lindisfarne Gospels*, written in Northumbrian dialect in the 10th century, and *Ormulum*, written in the Northeastern Midland dialect (circa 1180), play an important role for phonological reconstruction. Their orthographic conventions provide early evidence for the vowel length of the words. *Lindisfarne Gospels* used acute accents (′) and double vowels to designate stressed long vowels. The *Ormulum* also exploits a spelling convention to differentiate short and long vowels: A short vowel was followed by double graphs of a consonant, while a long vowel was followed by a single graph of a consonant. The Great Vowel Shift in early Modern English is an example of the later length-sensitive changes.

3) The data provided in this study are mainly from Campbell (1959:§283), Jones (1989:26), Hogg (1992:§5.203), and Ritt (1994:82).

4) There are further exceptions to HCL. In late West-Saxon, short vowels and diphthongs, /eo, y, o/, were raised and retracted between *w* and *r* instead of being lengthened: wurd 'word', swurd 'sword', wurðian 'honor'. (< word, sweord, weorðian) (Campbell, 1959; Hogg, 1992) We will not discuss them in this study and leave them for future study.

(2) Exceptions to HCL
a. cildru 'children', lambru 'lambs', cembde 'combed', heardra 'harder'
b. and 'and', under 'under', wolde 'would', sceolde 'should'

HCL seemed to be unstable throughout the history of English. By the end of the 14th century lengthening was maintained only before *mb* (for i, o), *nd* (for i, u), and *ld* (for all vowels) as in (3a). In Northern dialect, there was no lengthening before *-nd, -rd, -mb* as in (3b).[5]

(3) Homorganic Cluster Lengthening in Middle English
a. Chaucer: chīld, feeld, bīndan, bōūden, lōmb, clȳmben
cf. [ŏ]: soond, woord, soong
b. Northern dialect: fĭnd(e), bĭnd(e), clĭmb(e)

The lack of generality of HCL is also found in the *Ormulum*, one of the most important early ME manuscripts for phonological reconstruction. The vowels before the same homoragnic cluster were sometimes long and short in other times, as shown in (4).[6]

(4) Homorganic Cluster Lengthening in the *Ormulum* (Jones, 1989, p. 29)

	long vowels	short vowels
a. /ld/	: ald, gold, child, hald, shild	shillde, nollde, shullder
b. /mb/	: camb, climben, crumb, dumb	
c. /nd/	: grund, hand, land, fend, kinde	unnderr, stunnd, annd
d. /ŋg/	: gang, lang, sang, strengenn	lanne, brinngenn
e. /rd/	: hird, hord, ferd, ord, swerd, ærd	
f. /rn/	: corn, hirne, ærne	steornne
g. /rl/	: cherl	derrling, barrlig

The short vowels in (3)-(4) have been explained in different ways. First, the patchy characteristics of HCL is ascribed to the scribe's error: The scribe's marking is not consistent. On the other hand, Luick (1921) and Jordan (1974) suggest that HCL occurred to all of the vowels equally, but subsequent shortening affected various vowels differently before the Great

5) Final *-d* had been devoiced in this dialect.

6) For the spelling convention the *Ormulum* utilized, refer to fn. 2.

Vowel Shift. Another interpretation of the irregularity of HCL is that the original lengthening, rather than subsequent shortening, occurred to vowels sporadically (Jespersen, 1909). To take a step further, Minkova and Stockwell (1992) claim that 'Homorganic cluster lengthening with reference to any environment other than *-ld* is a misnormer'. In this paper, we follow Luick's (1921) position that all of the vowels were affected by lengthening equally at first, but they reacted differently when subsequent shortening took place, and attempt to explicate the motivation of vowel lengthening before voiced homorganic clusters.[7)]

Now let us briefly introduce the controversial issues concerning HCL. They are centered around three topics. First involves the relation between the cluster types in HCL. HCL is claimed to be a single sound change (Luick, 1921; Eliason, 1948; Malsch, 1976), while Saurauw (1921) and Minkova and Stockwell (1992) argue that HCL is a series of unrelated changes. The former is basically assumed in this study. The second controversial issue is the relation between HCL and the other quantitative changes in ME: OSL, TSS, and PCS. Most of the analyses attempt to connect HCL and other quantity sensitive changes in ME under one general tendency or a goal, although there are discrepancies on what the goal is. Contrary to this position, Minkova and Stockwell (1992) propose that HCL and other quantitative changes in ME were independent of one another. In this study we attempt to connect HCL and PCS. The most important and controversial issue on HCL seems to be what motivates HCL. The motivation for HCL and/or other quantitative changes in ME can be summarized as follows: i) maintenance of optimal syllable quantity; ii) sonorant lengthening; iii) phonetic (re)analysis. In the next section, we will discuss them in detail.

3. An Overview of Previous Analyses of HCL

3.1. Maintenance of Optimal Syllable Quantity

Luick (1898) argues the quantitative changes in stressed syllables in ME are a result of the tendency to bring the syllable quantity to a normal

7) We leave the later shortening for future study, although this seems to make this study half done.

level. According to Luick' normal quantity, stressed syllables in monosyllabic words are minimally bimoraic and have possible additional consonant (VCC, VVC). When in disyllabic words, they are composed of a vowel followed by a consonant (VC) or of a long vowel (VV). In trisyllabic words, they consist of a monomoraic vowel (V). HCL in LOE violates these norms; The homorganic clusters add extra length to an already well-formed syllable.[8] Hence, in order to accomodate HCL within a framework of abstract quantity equilibrium, Luick assigns the homorganic cluster the quantity of a single consonant.[9]

Malsch (1976) also depends on the optimal syllable size of stressed syllables. He argues that the quantitative changes in ME occurred to satisfy the Principle of Moric Stability saying that stressed syllables tend to stabilize at two moras. HCL also seems to violate the principle of moric stability; an increase in the optimal moric number within a stressed syllable (VCC > VVCC). Malsch's treatment of HCL, however, is different from Luick's (1898). Malsch claims that the sonorant consonants in the homorganic clusters function as syllabic nuclei.[10] This may allow an analysis consistent with the tendency to moric stability – two moras in each syllable.

Ritt (1994) proposes a probablistic approach to quantitative changes in ME.[11] In order to resolve the exceptional behavior of HCL, Ritt depends on coda reduction. The device reduces the homorganic clusters from two moras to one mora: Homorganic clusters share a single mora. The weight reduction allows him to unify OSL and HCL. For example, the first syllable of the words, *bi[nd]an* which is a HCL candidate and *ma[k]en* in which OSL is supposed to take place, would have 1.5 mora and undergo lengthening.

Under the attractive assumption called maintenance of optimal syllable, HCL always requires additional devices such as Luick's monoconsonantal treatment of the homorganic clusters, Malsch's assignment of syllabicity to

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8) Due to this reason, Minkova and Stockwell (1992) describe homorganic clusters as 'moric busters'.

9) Hogg's (1992) proposal of HCL revives Luick's claim, although he does not clarify how the optimal syllable structure is constituted.

10) Namely, the homorganic cluster itself constitutes an independent syllable as in *chi.ld, wi.ld* and *fie.ld.*

11) He proposes a rule for quantitative changes in EME as in (1).
(1) The rule of vowel quantity adjustments in early ME: The probability of vowel lengthening was proportional to the degree of stress on it, its backness and coda sonority.

resonants and Ritt's mora reassignment. In addition, the proposals reviewed are often criticized on the grounds that they cannot account for the irregularity of HCL and that they are not clearly motivated (Eliason, 1948; Minkova & Stockwell, 1992; Murray, 2000).

3.2. Sonorant Lengthening

Luick (1921) proposed a different account of HCL after the formulation of his first claim. At this time, he postulates HCL is sonorant lengthening as compensation: A circumflex accent caused an epenthetic vowel in all combinations of liquids or nasals followed by non-homorganic consonants. When the liquids or nasals were followed by homorganic consonants, no epenthetic vowels developed, and instead the liquid or nasal was lengthened as compensation for the loss of a final unstressed syllable. When a second accentual change occurred, the liquid or nasal was shortened if followed by a voiceless consonant. On the other hand, the length shifted from the liquid or nasal to the preceding vowel if followed by a voiced homorganic consonant. Luick's analysis can be schematized as in (5).

(5) HCL and other changes in accentual system

a. before homorganic clusters

blind → blinnd → bliind

↑ ↑

circumflex accent strong initial accent

b. before other clusters

wylf > wylif > wylif 'wolf' burg > burug > burg 'burgh'

Eliason (1948) notes that the claim shown in (5) has shortcomings. First, the claim cannot account for HCL of vowels in disyllables since the development of a circumflex is proposed by Sievers (1901) to occur only in monosyllables. Secondly, Eliason points out the hypothesis of the two changes in accent is not plausible.

Jones (1989) also considers HCL as sonorant lengthening. He bases his claim on Raphael's (1972) phonetic experiment and proposes that HCL was a vowel and sonorant lengthening in which the lengthened sonorant was vocalized.[12] Although Minkova and Stockwell (1992) argue against this

12) Raphael (1972) reports that a vowel and nasal before a voiced homorganic obstruent are longer than before a voiceless homoragnic obstruent in an acoustic experiment.

claim for the reason that it does not provide an account of lengthening before non-nasal clusters, the results of the phonetic experiments conducted by Chen (1970) and Lehiste (1972) support Jones' view, as will be seen in Section 4.[13]

3.3. Phonetic (Re)analysis

Eliason (1948) provides a phonetic interpretation of HCL and PCS. He considers the vowel variation before consonant clusters was caused by the different amount of energy required by the clusters. He argues that vowel shortening occurred before two or more heterosyllabic non-homorganic consonant clusters due to the increase in the amount of energy required by the clusters. By contrast, vowel shortening failed before homorganic clusters since they required less energy than combinations of other consonants. Furthermore, since the homorganic clusters were tautosyllabic, they require less energy than similarly constituted heterosyllabic groups.[14] He views HCL as an indirect result of analogy: Vowel shortening brought about loss of distinction between long and short vowels. This partial coalescence into a short vowel before the nonhomorganic clusters was extended analogically to vowels before the other consonant clusters. However, before the voiced homorganic clusters, the coalescence was under the long rather than the short vowel.

On the basis of Chen's (1970) phonetic experiment, Phillips (1981, 1983) claims that HCL is caused by a universal phonetic tendency to lengthen vowels before homorganic clusters. In accordance with this tendency, speakers of LOE and EME began lengthening vowels before homorganic clusters and created a process of phonologization. How the process occurred in three diachronic stages is demonstrated in the following table.

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13) As in the argument against the claim of maintenance of optimal syllable structure, Minkova and Stockwell (1992) provide the same criticism: the absence of the account of the numerous exceptions to HCL. This argument seems to be an inevitable consequence, given that the ultimate goal of their theory is to deny the existence of so-called HCL itself, except for lengthening before *-ld* cluster.

14) Later phonetic experiments show that the phonetic account of vowel duration variability by the energy expenditure is controversial. Belasco (1953) supports this view, while it is refuted by Zimmerman and Sapon (1958), and Chen (1970).

(6) Precluster lengthening and shortening (Phillips, 1983, p. 881)

Stage I	1 v̆ pt	2 v̆ ld	3 v̄ pt	4 v̄ ld
Stage II	1 v̆ pt	3 v̆ ld	3 v̄ pt	4 v̄ ld
Stage III	1 v̆ pt		3 v̄ pt	4 v̄ ld, v̆ ld

1 2 3 4

Scale of vowel length: shortest ----------> longest

v̆ = original short vowel v̄ =original long vowel

Vertical dotted line indicates phonemic boundary between short and long vowels. *ld* indicates the so-called homorganic clusters. *pt* indicates other two-consonant clusters.

Minkova and Stockwell (1992) argue against Phillips' theory for two reasons. First, they suggest that phonetic differences alone never result in phoneme change, but additional factors must have been intervened. Secondly, they state that the results of Chen (1970) are from Modern English and hence they cannot be attributed to lengthening vowels before nasal/liquid plus homorganic clusters in ME.

Minkova and Stockwell (1992) also provide a phonetic account of HCL, although they assert that only vowel lengthening before *-ld* cluster can be named as HCL. The *l* in *ld* is dark *l*, which generates a schwa like the glide between a preceding vowel and *l*. The sequence of the vowel and the glide is reassigned to the nearest long vowel phoneme.[15)]

4. Vowel Length Variation before Homorganic Clusters in Modern Languages

Many phonetic studies show that vowel length varies depending on the voicing characteristics of the following consonant in Modern languages. It is found that English vowels are generally longer before voiced consonants than voiceless ones (House & Fairbanks, 1953; Peterson & Lehiste, 1960; Chen, 1970; Umeda, 1975; Lauefer, 1992). This seems to be confirmed cross-

15) This phonetic account can be illustrated as follow:

gołd → goəłd → gōłd

↑ breaking ↑ merge with a long vowel

linguistically (Chen, 1970; Port et. al., 1980; Mitleb, 1981; Lauefer, 1992).[16] For example, Chen (1970) demonstrates that French, Russian, Korean, and English show the same pattern.[17] He tentatively concludes that the invariable variation of vowel duration can hardly be regarded as accidental, but it is a language-universal phenomenon. Mitleb (1981) indicates that in German the longer duration of vowels before voiced consonants play a role of strong perceptual cue of 'voicing' in obstruents.

In addition, many studies demonstrate that like the vowels, the sonorants tend to be longer before voiced stops than before voiceless stops (Potter et al., 1966; Chen, 1970; Raphael, 1972; Raphael et al., 1975; Sato, 1993).[18] Raphael et al. (1975) report that in CVNC syllables in English the duration of the nasal exerts a greater influence on the perception of voicing distinctions in the following consonant than does the duration of the vowel. As already mentioned in Phillips (1983), Chen (1970) found that English sonorants become longer before a voiced consonant than a voiceless consonant.[19] In the experiment, the durational effect by the following consonant was not limited to the immediately preceding sonornant alone, but spread to the vowel as well: The voicing of the consonantal environment exercised durational influence on the vowel-sonorant sequences as a whole. This is supported by Lehiste (1972). She observed that the vowel-sonorant sequences in a C(R)V(R)C syllable fuse into one timing unit: 'both the vowel and postvocalic resonant are subject to either shortening or lengthening, depending on the voicing of the final obstruent.'[20]

The phonetic studies we have seen up to now appear to partly corroborate Luick's (1921) and Jones' (1989) phonetic approach to HCL: HCL as sonorant lengthening. In this paper, we also basically assume that HCL is lengthening of the vowel-sonorant sequence as a unit and the sonorant

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16) Refer to Keating (1985) for exceptions.

17) In case of English, he measured vowel length of the following words: *lap/lab, fat/fad, lack/lag, ample/amble, sent/send, kilt/killed, bank/bang.*

18) Potter et al. (1966) provide spectrograms of *camp, amber, seemed, can't, end, thank, hanged, finger* as evidence. Raphael et al. (1975) conducted both a spectographic analysis and a perception test on the duration of the nasal in the following words: *pent/pend, cant/canned, pint/pinned, daunt/dawned, stunt/stunned, sent/send.*

19) The data used in the experiment are as follows: *lumper/lumber, sent/send, linker/linger, cinch/singe, hence/hens, help/helb, kilt/killed, bulk/bulg, belcher/Belgian, false/falls, harp/harb, cart/card, burke/berg, perch/purge, surf/serve, course/cores.*

20) The data Lehiste (1972) used in the experiment include *plant/planed, tart/tarred, built/build, clamp/clamb.*

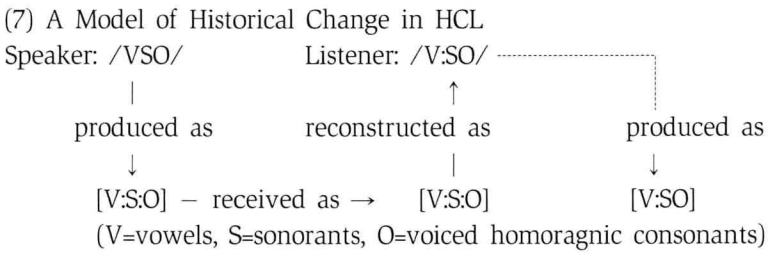
lengthening increases perceptual salience of vowel length. In the next section, it will be shown how the assumption can be substantiated by a constraint and how the constraint interacts with the other constraints.

5. An Optimality-theoretic Analysis: Unification of HCL and PCS

In this section, we will explore what constraints are active in HCL together with PCS. It will be shown that Optimality Theory (OT) (Prince & Smolensky, 1993; McCarthy & Prince, 1995) allows us not only to easily incorporate the causal factors that influence HCL, but also to unify HCL and PCS, with the help of the basic tenets of OT such as interaction of violable constraints. The proposed analysis will demonstrate that the hierarchy of the constraints for HCL can choose an optimal output of PCS, whereby the seemingly incompatible changes are unified under the same hierarchy of the constraints.

On the basis of the phonetic studies discussed in Section 4, it is assumed that HCL would have occurred under the following scenario schematized in (7) which is primarily based on Ohala's (1986) model of top-down processing in speech perception.

(7) A Model of Historical Change in HCL



According to the scenario in (7), speakers in ME pronounced the vowel-sonorant sequence as long before a voiced homoragnic consonant. However, listeners perceived that only vowel in the sequence was lengthened and therefore reconstructed it as /V:SO/.

If it is the case, the question we have to answer is how phonetic properties that are predictable become the properties that are unpredictable and purposeful, i.e. phonologized. Ohala states that a (historical) change occurs when listeners fail to factor out the contextually predictable process, i.e. when the context is lost or when listeners confuse cause and target. Then,

which case does HCL belong to? It is, however, difficult to determine which type of change HCL is. Since the homorganic clusters are not lost, it cannot be said that phonologization of vowels lengthened by HCL was triggered by the context loss. HCL does not appear to occur due to confusion between cause and target, either. HCL does not seem to be fit in with either of the cases. Nevertheless, what brought about phonologization of the predictable vowel length? It can be thought that the phonologization was caused by the lengthened sonorant which increased the perception of vowel length.[21] Then, why are only the vowels perceived as long, and why not the sonorants? For this it can be hypothesized that listeners in ME might have confused sonorant and vowel length, and considered the former as the latter. This hypothesis may not be totally untenable, given the following reasons. First, sonorants are similar to vowels than any other consonants. Second, listeners in ME would have had difficulties in identifying sonorant length since geminates were disappearing at that time.

In order to substantiate the fact that only vowels are perceived as long, I propose a constraint in (8), which is conjoined by two constraints.

(8) LV/vdO & LS/vdO
  a. LV/vdO: Lengthen a vowel before a voiced obstruent which is not followed by a consonant.
  b. LS/vdO: Lengthen a sonorant before a voiced homorganic obstruent which is not followed by a consonant.

The conjoined constraint in (8) is violated only when both a vowel and a sonorant are not lengthened before a voiced homoraganic obstruent. Under the conjunction of two constraints, lengthening a vowel and/or a sonorant before a voiced homorganic obstruent is allowed.

In addition to the conjoined constraint, I propose a set of constraints given in (9) which would play a role of creating optimal syllable structure in ME.

21) It can be said that the phonetic length of sonorants is transferred to phonological length of the preceding vowels as Jones (1989) suggests.

(9) Constraints regulating optimal syllable structure
a. FTBIN: Feet are syllabically or moraically binary.
b. $*\sigma_{\mu\mu\mu}$: Trimoraic syllables are not allowed.
c. WeakEdge (P-CAT)(WkEd): The right periphery of P-Cat should be empty. (Spaelti, 2002)
d. Sonority Sequencing Principle (SSP): A nucleus constitutes the sonority peak in a syllable, with sonority decreasing towards the margins.
g. *APPENDIX: Appendix consonants are not allowed. (Sherer, 1994)
h. $*\mu$/cons: Moraic coda consonants are not allowed. (Sherer, 1994)

Rosenthall and van der Hulst (1999) account for variable closed syllable weight with the help of the interaction of (9g, 9h) and other constraints. However, the interaction of *APPENDIX and $*\mu$/cons is not enough to predict the syllable pattern in ME. Monosyllable words with VVC rhyme did not undergo shortening in ME. As Bermúdez-Otero (1998) points out, this indicates that final consonant extrasyllabicity was required in ME. In order to allow final consonant extrasyllabicity, we depend on the constraint WeakEdge which is first proposed by Spaelti (2002), and adopted by Bermúdez-Otero in the name of WeakC when he explains OSL, PCS, and TSS. WeakEdge conflicts with *APPENDIX, which is resolved by ranking the former over the latter in LOE and ME.

A series of quantitative changes of vowels in ME incur the violation of the following constraint.

(10) Weight-Ident (WT-ID): Monomoraic input vowels are monomoraic in the output. Bimoraic input vowels are bimoraic in the output. (McCarthy, 1995)

In order to account for the distribution of vowel shortening and lengthening in ME, the constraint in (10) needs to be decomposed into two subconstraints as in (11). One prohibits vowel lengthening, while the other prohibits vowel shortening.[22] Other constraints intervene between them

22) At a glance, the constraints in (11) look like moraic faithfulness constraints such as DEP-IO(μ) and MAX-IO(μ). However, they make a different prediction since WT-ID/V and WT-ID/$\bar{V}$ are relevant only with vowel length, while moraic faithfulness constraints prohibit the change in the moraic status of vowels and consonants. In this analysis, WT-ID/$\bar{V}$ and MAX-IO(μ) can be used interchangeably, whereas DEP-IO(μ) and WT-ID/V cannot. The difference will be mentioned in the discussion of the relevant tableaux below.

in the hierarchy of the constraints.

(11) a. Weight-Ident/V (WT-ID/V): Monomoraic input vowels are mono moraic in the output. (No V-lengthening)
b. Weight-Ident/V̄(WT-ID/V̄): Bimoraic input vowels are bimoraic in the output. (No V-shortening)

The constraints proposed up to now can be ranked as in (12), in order to winnow an optimal output for HCL (and together with PCS).

(12) Constraint Hierarchy for HCL and PCS (to be revised)
FTBIN, $*\sigma_{\mu\mu\mu}$, SSP, LV/vdO & LS/vdO ≫ WT-ID/V ≫ WeakEdge ≫ *APPENDIX ≫ WT-ID/V̄ ≫ $*\mu$/cons ≫ LV/vdO, LS/vdO

How the constraint hierarchy in (12) operates to select an optimal output is illustrated in (13).

(13) cīldes gen.sg. of cīld 'child'[23]

/čildes/	FT BIN	$*\sigma_{\mu\mu\mu}$	SSP	LV/vdO &LS/vdO	WT-ID/V	Weak Edge	*APP	WT-ID/V̄	$*\mu$ /cons
a. μμ μ | | | č i l. d e s				*!			*		*
☞b. μμ μ |/ | č i l. d e s					*		**		
c. μμ μ μ |/ | | č i l. d e s		*!			*		*		*
d. μμ μ μ |/ |/ | č i l. d e s		*!	*!		*		*		*
e. μμ μ | |/ | č i l. d e s			*!				*		*
f. μ μ | | č i l. d e s	(*!)			*!			**		

23) A dot in the candidates indicates a syllable boundary.

The absence of vowel lengthening as in (13a) and (13f) incurs a fatal violation of the conjoined constraint, LV/vdO & LS/vdO, since either a vowel or a sonorant is not lengthened. Although lengthening both the vowel and the following sonorant satisfies LV/vdO & LS/vdO, it leads to a fatal violation of the constraint banning a superheavy syllable, as shown in (13c) and (13d). In LOE and EME, lengthening either the vowel or the sonorant, but not both, can meet both the constraints, LV/vdO & LS/vdO and $*\sigma_{\mu\mu\mu}$ at the same time. However, lengthening of the sonorant results in a fatal violation of SSP, as in (13d) and (13e).[24] (13f), which lengthens neither a vowel nor a sonorant, incurs a fatal violation of LV/vdO & LS/vdO as in (13a).[25]

Then, how is vowel length in the input maintained when a vowel immediately precedes a voiced obstruent? The words of this case meet the conjoined constraint, LV/vdO & LS/vdO, since LS/vdO is vacuously satisfied. However, the phonetic tendency that a vowel is longer before a voiced obstruent than a voiceless obstruent, which is formulated as a constraint, dubbed as LV/vdO, would require the vowel length to be neutralized before a voiced obstruent. This conflict is resolved by ranking LV/vdO below the constraints barring change of vowel weight such as WT-ID/V and WT-ID/V̄.

First, let us turn to an example that has a short vowel before a voiced obstruent.

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24) In this study, the long consonant, or a geminate, is assumed to be linked both to the coda of the preceding syllable and to onset of the following syllable in the output. However, when a word ends with the homorganic cluster as in *cɨld* nom.acc. of *cɨld* 'child', a candidate with a lengthened sonorant cannot realize its length since there is no syllable following the sonorant. Therefore, such candidate would always violate LV/vdO & LS/vdO, if the vowel preceding the sonorant was not lengthened.

25) Depending on how (13f) constitutes its internal foot structure, it could incur an additional fatal violation. If two feet are constructed in the candidate as in [čil][des], this brings about a fatal violation of FTBIN. If (13f) consists of one foot as in [čildes], the foot structure meets FTBIN.

(14) god 'god'[26]

/god/	FT BIN	$*\sigma_{\mu\mu\mu}$	LV/vdO &LS/vdO	WT-ID/V	Weak Edge	*APP	WT-ID/$\bar{V}$	$*\mu$/cons	LV/vdO
a. μ | g o d	*!					*			*
b. μμ |/ g o d				*!		*			
☞c. μ μ | | g o d					*			*	*
d. μμ μ |/ | g o d		*!		*	*	*		*	

Lengthening a vowel before a voiced obstruent to satisfy LV/vdO as in (14b) is not allowed due to a fatal violation of WT-ID/V that bars the weight change of a monomoraic vowel. Instead, assignment of a mora to a coda consonant via Weight-by-Position is forced by FTBIN at the expense of WeakEdge and $*\mu$/cons. The evaluation of the candidates (14b) and (14c) indicates that DEP-IO(μ) cannot replace WT-ID/V. DEP-IO(μ) prohibits the insertion of a mora, regardless of whether a mora is assigned to a vowel or a consonant in the output, and hence the candidates tie in the violation of DEP-IO(μ).[27]

Long vowels preceding a voiced obstruent surface as long. Unlike (14b), (15b) does not bring about the violation of WT-ID/V. Rather, shortening of the long vowel incurs a fatal violation of FTBIN or WeakEdge as (15a) and (15c) illustrate.

26) The constraints which are not crucial in selecting an optimal output are not indicated in the tableaux that will be introduced from now on, due to lack of space.

27) Bermúdez-Otero (1998) utilizes DEP-IO(μ) in the account of PCS, instead of WT-ID/V. He considers the candidate such as (14b) does not violate DEP-IO(μ). However, I think it would be impossible for (14b) to satisfy DEP-IO(μ) without stipulating other assumptions.

(15) gōd 'good'

/gōd/	FT BIN	$*\sigma_{\mu\mu\mu}$	LV/vdO &LS/vdO	WT-ID/V	Weak Edge	*APP	WT-ID/$\bar{V}$	$*\mu$/cons	LV/vdO
a. μ | g o d	*!					*	*		*
☞b. μμ |/ g o d						*			
c. μ μ | | g o d					*!		*	*	*
d. μμ μ |/ | g o d		*!			*			*	

As mentioned before, how to unify HCL and PSC in an analysis has been one of the controversial issues in the account of the quantitative changes of vowels in ME. This is because both changes take place before CC-clusters, but vowels are shortened in one process and are lengthened in the other. Unlike HCL, vowels are shortened when they follow consonant clusters that are not voiced homorganic clusters as in (16).

(16) Pre-Cluster Shortening (PCS) in ME

OE:	ME:	
cēpte	kepte	'kept' cf. kēpe(n) 'keep'
fīfta	fifte	'fifth'
brōhte	brohte	'brought'
gōdsibb	god-sib	'gossip'

The tableaux in (17) illustrates that the same hierarchy of constraints that explains HCL correctly predicts the distribution of vowels shortened by PCS, as well. The difference between the changes is that LV/vdO & LS/ vdO is irrelevant in the selection of optimal outputs of PCS. The remaining constraints and their relative ranking force vowels to be shortened before CC clusters that are not homorganic clusters. Maintenance of a long vowel in the output results in a fatal violation of $*\sigma_{\mu\mu\mu}$ or *APPENDIX as seen in (17b) and (17c).

(17) kept pret. of kēpe(n) 'to keep'

/kēpt/	FT BIN	$*\sigma_{\mu\mu\mu}$	SSP	LV/vdO &LS/vdO	WT-ID/V	*APP	WT-ID/$\bar{V}$	$*\mu$ /cons
☞a. μ μ | | k e p t						*	*	*
b. μμ |/ k e p t						**!		
c. μμ μ |/ / k e p t		*!				*		*

As already mentioned in Section 2, HCL is sometimes blocked: when homorgarnic clusters are followed by a third consonant as in *cildru* 'children'; or when vowels preceding homorganic clusters are unstressed. Let us consider the first type of the exception.

(18) cildru pl. of cīld 'child'

/čildru/	FT BIN	$*\sigma_{\mu\mu\mu}$	SSP	LV/vdO &LS/vdO	WT-ID/V	*APP	$*\mu$ /cons
☞a. μμ μ | | | č i l. d r u							*
b. μμ μ |/ | č i l. d r u					*!	*	
c. μμ μ μ |/ / | č i l. d r u		*!			*		*
d. μμ μ μ |/ | / | č i l. d r u		*!	*!		*		*
e. μμ μ | | / | č i l. d r u			*!				*
f. μ μ | | č i l. d r u						*!	

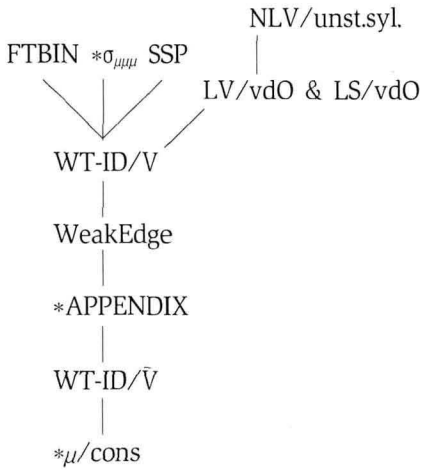
The conjoined constraint, LV/vdO & LS/vdO, does not participate in the selection of an optimal output for the words with a vowel followed by CCC clusters. The remaining constraints and their hierarchy winnow the optimal output.

In order to account for the second exception, I would like to propose a constraint in (19). I introduce positional markedness into the constraint first proposed by Sherer (1994).

(19) No Long Vowel/unstressed syllable (NLV/unst.syl.): A long vowel is not allowed in an unstressed syllable.[28]

The positionally marked constraint in (19) is ranked above LV/vdO & LS/vdO. (12) is revised as in (20).

(20) Constraint Hierarchy for HCL and PCS



The revised hierarchy of the constraints in (20) prevents the target vowel of HCL from lengthened when it is unstressed as illustrated in (21).

28) This constraint would constitute a hierarchy with the constraint that bans a long vowel in a stressed syllable as follows: NLV/unst.syl. ≫ NLV/st.syl.

(21) wolde 'would'

/wolde/	FT BIN	$*\sigma_{\mu\mu\mu}$	SSP	NVL/ unst	LV/vdO &LS/vdO	WT-ID/V	Weak Edge	*APP	$*\mu$ /cons
☞a. μ μ μ | | | w o l. d e					*			*	*
b. μμ μ |/ | w o l. d e				*!		*		**	
c. μμμ μ |/ | w o l. d e		*!		*!		*		*	*
d. μμμ μ |/ |/ | w o l. d e		*!	*!	*!		*		*	*
e. μ μ μ | |/ | w o l. d e			*!					*	*
f. μ μ | | w o l. d e					*			**!	

Lengthening a vowel in an unstressed syllable to meet LV/vdO & LS/vdO incurs a fatal violation of the constraint that bans a long vowel in an unstressed syllable. Lengthening a sonorant results in /ld/-cluster in the onset of the following syllable, which is fatal to be an optimal output, although it does not violate NLV/unst.syl. Candidate (21a) which better satisfies *APPENDIX than (21f) is selected as an optimal output.

6. Conclusion

In this study, we have discussed what constraints interact to account for HCL. The proposed analysis has shown that many factors proposed as a motivation of the quantitative changes in the previous analyses are not mutually exclusive, but they interact with one another as constraints, i.e. are ranked in the hierarchy. We can easily incorporate them with the help of basic tenets of OT such as violability of universal constraints. The proposed analysis has demonstrated that HCL and the seemingly contradictory change, PCS, can be unified under the same hierarchy of constraints. HCL is shown to be neither incompatible with PCS, nor exceptional.

In this analysis, it has been proposed that HCL takes place due to the

phonetic tendency that vowels and sonorants are longer before a voiced homorganic obstruent than before a voiceless one. However, only the vowel in the sequence of vowel and sonorant was perceived as phonemically long in ME, which is correctly captured by the conjunction of constraints in this analysis. In addition, the absence of phonemic lengthening of vowels which immediately precedes a voiced obstruent has been simultaneously explained through the relative ranking of the proposed conjoined constraint and other constraints.

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An-Nah Moon
Department of English Education
College of Education
Inha University
253 Younghyun-dong, Nam-gu
Incheon 402-751, Korea
E-Mail: anmoon@inha.ac.kr

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