Lexicon-dependent Optimality Theory*

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Lee, Jae-Young. 2004. Lexicon-dependent Optimality Theory. *Studies in Phonetics, Phonology and Morphology*. 10.1. 69–88. This paper aims at providing an extended Optimality Theory (OT) in which human mental lexicon is highly valued in phonological grammar. Current mainstream OT does not focus its concern on the lexicon. This paper seeks to offer a more straightforward explanation for English allomorphy and stress by taking the lexicon into serious consideration. This paper claims that some portion of English allomorphy and stress poses challenge to the OT assumption that the lexical input plays no significant role in grammar, the assumption being embodied by the Richness of the Base principle. However, some types of English allomorphy and stress patterns show that lexical information affects the evaluation of output well-formedness. Thus, this paper claims that dependence on the lexicon gives a simpler analysis of English allomorphy and stress patterns than disregard of the lexicon does, and that the lexicon-sensitive analysis broadens the latitude of OT. **(Seoul National University)**

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1. Introduction

It has generally been assumed in the generative tradition that the capacity of human brain is designed 'in such a way as to minimize the amount of information that must be stored in the speaker's mental lexicon' (Kenstowicz 1994: 60). This might be referred to as the economy of storage assumption. However, the economy assumption is neither self-evident nor unchallenged in the generative literature. Based on the results from neural science, the economy assumption is not compelling in itself and can be challenged (Kenstowicz 1994: 70). Some proposals in Optimality Theory (Prince and Smolensky 1993, OT hereafter) like Uniform Exponence (Kenstowicz 1996) and Anti-Allomorphy (Burzio 1996) implicitly abandon the economy assumption and presuppose the existence of a very powerful, rather than economic, lexicon.

In this paper, contrary to the economy of storage assumption, I make an assumption that the mental lexicon can contain as much information as possible in such a way to minimize unpredictability and indeterminacy in

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phonology. With the assumption in mind, I will argue for the necessity of maximal utilization of the lexicon even in output-oriented OT. Current mainstream OT holds the assumption that the lexical input plays no significant role in selecting the optimal output among possible output candidates by the phonological grammar which consists of constraints. The first argument advanced in this paper for the necessity of maximal lexicon utilization is that OT combined with Morpheme Alternant Theory, which allows in the lexicon multiple inputs rather than a single underlying form for allomorphs, is more appropriate to explain English allomorphy than is OT with a single-input approach to allomorphy. The second one is to show that current mainstream OT, a lexicon-insensitive theory, has difficulty in explaining the unpredictability of inserted vowels in English allomorphy. The last argument is to justify the necessity of lexical stress in accounting for some portion of English stress within the framework of OT. This paper thus claims that we need to take the input more seriously even in the output-oriented theory of OT.

I will first, in section 2, discuss English consonantal allomorphy and explain it within the OT framework relying on a multiple-input approach to allomorphy in which allomorphs are listed in the lexicon. I will then, in section 3, examine the unpredictability of segmental insertion in English allomorphy and provide a lexicon-sensitive OT analysis of the allomorphy related to unpredictable segmental insertion. In section 4, I will consider the unpredictability of some stress patterns in English and present an OT analysis of it on the basis of lexical stress markings. Finally, section 5 will conclude the paper by summarizing the discussion.

2. Multiple inputs in the lexicon for allomorphy

I have argued in Lee (2002) that the multiple-input approach to allomorphy represented by Morpheme Alternant Theory can account for English allomorphy in an explanatory and more straightforward way within the framework of OT, by examining English vocalic alternations. Morpheme Alternant Theory, which was taken by American structuralists in the 1940s and 1950s, is a theory claiming that allomorphs do not have a single underlying representation (UR) but instead should be listed in the lexicon, as illustrated in (1).

(1) a. electri/k,s/ + al
    b. electri/k,s/ + ity

The allomorphs *electri/k/* and *electri/s/*, respectively, are listed in the lexicon along with suffixes *–al* and *–ity*.

In a single-UR approach to allomorphy adopted in Chomsky and Halle (1968) and other subsequent generative works including current mainstream OT, on the other hand, allomorphs are assumed to derive from a single UR. Under this approach, the allomorphs *electri[k]* and *electri[s]*, for example, result from the single UR *electri/k/*.

In this section I will show that English allomorphy is easily explained in the OT framework combined with the multiple-input approach rather than under the OT framework with the single-UR approach, by examining the phenomenon of Velar Softening, a representative case of English consonantal allomorphy.

Velar Softening, as exemplified in (2) below, is the phenomenon in which the velar stop /k/ changes into [s] before a nonlow front vowel.[1]

(2) electrical ~ electricity; opaque ~ opacity; authentic ~ authenticity

This phenomenon can be captured in the rule-based derivational model by the following rule:

(3) Velar Softening: /k/ $\rightarrow$ [s] / ___ V [-low, -back]

Under the single-UR approach stemming from *SPE*, it has been claimed that Velar Softening also occurs to the underived forms like those in (4b). It is thus said that simplicity/economy is acquired for English phonology due to Velar Softening. All tokens of [s] in a certain specific context are derived from the same underlying /k/ by a single rule of Velar Softening. There is no need in this view to postulate two underlying forms /k/ and /s/ in the lexicon.

(4) a. derived forms: skepticism, empiricism
    b. underived forms: reduce (redu[k]tion), induce (indu[k]tion), re[s]ede, re[s]eive

However, as exemplified in (5), Velar Softening does not apply to the words with potential undergoers. The difference in the target and trigger of Velar Softening between words in (4) and those in (5) cannot be explained in a consistent way.

(5) a. derived forms: anar[k]ism
    b. underived forms: kitty, kiss

[1] The change of [g] into [dʒ] (e.g. *rigor* ~ *rigid*, *turgor* ~ *turgid*, *analogous* ~ *analogist*), which is not discussed here for the sake of simplicity, is also part of Velar Softening.

The stem-final /k/ in (5a), unlike that in (4a), remains unscathed before a suffix containing the high front vowel /i/, the trigger of Velar Softening. In (5b) above, word-initial /k/ remains intact before the front vowel /i/. As evident in examples like ***reduce***, ***recede***, and ***receive***, the triggering vowel constitutes part of an independent morpheme: *re+duce*; *re+cede*; and *re+ ceive*. The conditioning vowels are not derived either from a juxtaposition of morphemes or from an application of other rules. Thus, the triggering vowels do not constitute a derived environment. Moreover, the target consonants do not result from application of other rules. That is, the non-derivedness blocking effect does not apply to the Velar Softening phenomenon. Therefore, the underived words ***kitty*** and ***kiss*** are incorrectly predicted to undergo Velar Softening. This problem cannot be explained in a principled and consistent way by current mainstream OT with the single-UR approach as well.

A more serious problem with OT with the single-UR approach surfaces when other phenomena such as Spirantization and *s*-Voicing are taken into consideration along with the Velar Softening phenomenon. With regard to the surface form [s], there might be several options for postulating a single UR. When we come across the output sound [s], we have several possibilities to postulate a single corresponding UR since [s] can alternate with /t/, /d/, /z/, or /k/ in English allomorphy, as evidenced in (6).

(6) Consonant alternations

a. [s] ~ [t]	(Spirantization)	e.g. residen**c**y ~ residen**t**
b. [s] ~ [d]	(Spirantization)	e.g. eva**s**ive ~ eva**d**e
c. [s] ~ [z]	(*s*-Voicing)	e.g. gymna**s**tics ~ gymna**s**ium
d. [s] ~ [k]	(Velar Softening)	e.g. electri**c**ity ~ electri**c**al

We would not predict the alternations in a simple way if we adopted the single-UR approach in OT. The surface form *evasive*, for example, is eligible to undergo *s*-Voicing like *gymnasium* with the resultant consonant [z] intervocalically since it fits the structural description of the *s*-Voicing rule in that the target /s/ is preceded by a long vowel and followed by a vowel in exactly the same way as *gymnasium*. However, *s*-Voicing does not apply to the word *evasive*. The underapplication of *s*-Voicing in *evasive* could not be explained in a straightforward way without assuming the specific correspondence, [s] ~ [d]. The segment [s] would be freely corresponding to [z], [t], and [k]. This kind of problem is a burden to current mainstream OT drawing on the single-UR approach.

Current mainstream OT with the single-UR approach reveals other problems in explaining the Velar Softening phenomenon. First, when we posit /k/ as a single UR for the allomorphy seen in *electricity* and *electrical*, we are faced with a problem of choosing an optimal candidate. As evidenced in (7) below, if the candidate *electri[s]ity* is selected as optimal over *electri[t]ity*, *electri[g]ity*, *electri[dʒ]ity*, or *electri[D]ity*, the reason should be independently explained why the sequence [si] is more harmonic in terms of markedness than the sequence [ti], [gi], [dʒ], or [Di]. The competing candidates satisfy the markedness constraint *ki as well as the winner *electri[s]ity*.

(7)

electri/k/+ity	Markedness(*ki)	Faithfulness
a. electri[k]ity	*!	
? b. electri[s]ity		*
? c. electri[g]ity		*
? d. electri[t]ity		*
? e. electri[dʒ]ity		*
? f. electri[D]ity		*

electri/k/+al	Markedness(*ki)	Faithfulness
☞a. electri[k]al		
b. electri[s]al		*!
c. electri[g]al		*!
d. electri[t]al		*!
e.electri[dʒ]ity		
f. electri[D]ity		

Change in constraint ranking may not be helpful here. The opposite constraint ranking, Faithfulness >> Markedness, wrongly choose *electri[k]ity* as optimal, as shown in (8). Candidate (8a), rather than the surface form *electri[s]ity*, is predicted to be the winner.

(8)

electri/k/+ity	Faithfulness	Markedness(*ki)
☜a. electri[k]ity		
b. electri[s]ity	*!	
c. electri[g]ity	*!	
d. electri[t]ity	*!	

electri/k/+al	Faithfulness	Markedness(*ki)
☞a. electri[k]al		
b. electri[s]al	*!	
c. electri[g]al	*!	
d. electri[t]al	*!	

Both constraint rankings fail to select the candidate *electri[s]ity* as optimal when *electri/k/* is postulated as a single UR for the allomorphs *electri[k]* and *electri[s]*.

Postulation of /s/ as a single UR is no help to explain the allomorphy as well, as illustrated in (9). Both constraint rankings between markedness and faithfulness also fail to select the most harmonic output as the actual surface form. Ranking of markedness over faithfulness dictates the candidate *electri[s]al* to be the winner, which is not an anticipated surface form.

(9)

electri/s/+al	Markedness(*ki)	Faithfulness
a. electri[k]al		*!
☜b. electri[s]al		
c. electri[g]al		*!
d. electri[t]al		*!

The opposite constraint ranking also could not select the surface form *electri/k/al* as optimal. The dominance of markedness by faithfulness would choose the candidate *eletri[s]a*l as optimal, as seen in (10) below.

(10)

electri/s/+al	Faithfulness	Markedness(*ki)
a. electri[k]al	*!	
☜b. electri[s]al		
c. electri[g]al	*!	
d. electri[t]al	*!	

On the other hand, the multiple-input approach to allomorphy within OT overcomes the problems addressed above, and can offer a simpler explanation for allomorphy than the single-input approach. As mentioned earlier in this section, under the multiple-input approach to allomorphy, the allomorphs are listed in the lexicon: e.g. /electri{k,s}/, /æl/, /ɪtɪ/. The lexical information is highly valued. I assume here that morphology is responsible for the input which goes through GEN: /electri{k,s} + æl/, /electri{k,s}+ ɪtɪ/.

It is worthwhile to note in passing that we need to distinguish allomorphy from allophony even in the OT framework. Allomorphy, which shows phonemic alternations, is motivated by both morphology and phonetics while allophony, which is non-phonemic realizations of a single phoneme, is mainly grounded by phonetics only. Therefore, in OT allophony can be easily explained by ranking well-formedness constraints over faithfulness constraints, regardless of what the input looks like.

However, allomorphy cannot be accounted for in the same way as allophony. Higher-ranked well-formedness constraints cannot decide the optimal output among output candidates in a principled way. The distinction between allomorphy and allophony is motivated in the generative tradition. Lexical Phonology (Kiparsky 1982, Halle and Mohanan 1985) distinguishes English allomorphy from English allophony by dividing phonology into two subparts: lexical and postlexical phonology. It is, thus, not surprising that allomorphy is explained in somewhat different way from allophony even in OT.

Let us now examine the words *electrical* and *electricity* as an illustration of the lexicon-dependent OT analysis proposed here to account for English allomorphy. The constraints immediately relevant here are IDENT-IO(F), IDENT-STRESS, and *[αback][-αback].

(11) a. IDENT-IO(F): Output correspondents of an input [γF] segment are also [γF].
b. IDENT-STRESS: If α is stressed, then *f*(α) must be stressed.
c. *[α back][-α back]: Horizontal tongue movement from onset to peak should not occur in direct opposite direction.

The constraint *[α back][-α back] seems to be roughly defined and is yet to be refined. The main point here, however, is that this constraint is a subfamily of the constraint family demanding place assimilation: Velar Softening is viewed as a sort of place assimilation here.

The correct selection of allomorphs under consideration is achieved by the following constraint hierarchy:

(12) IDENT-IO(F), IDENT-STRESS >> *[α back][-α back]

The application of this constraint ranking is illustrated in the tableaux given below.[2] Let us first consider the selection of *electri[s]ity*. As seen in tableau (13), the winner incurs a lesser violation of IDENT-IO(F) than other competing candidates.

(13)

Input: electri{k,s}ity Relevant form: eléctri[k]al	IDENT -IO(F)	IDENT -STRESS	*[αback] [-α back]
☞a. electrí[s]ity	**	*	
b. electrí[k]ity	**	*	*!
c. electrí[t]ity	***! [t]	*	

2 Detailed transcriptions are not given here and below except for the cases which otherwise would result in serious obscurity.

Candidate (13a), the winner, satisfies the markedness constraint *[α back][-α back] better than candidate (13b). Due to schwas in unstressed position, all candidates violate IDENT-IO(F). Candidate (13b) violates *[α back][-α back] since the *ki-* sequence shows the concatenation of [+back] and [-back]. I follow *SPE* in assuming that velars are [+back]. Alveolars and postalveolars are [-back], according to *SPE*. Candidate (13c) severely violates IDENT-IO(F) due to [t]. The dominance of *[α back][-α back] by IDENT-IO(F) correctly predicts candidate (13a) to be the winner. All candidates violate IDENT-STRESS since they have primary stress on the third syllable *tri-* while the relevant word *electrical* has a stress on the second syllable *lec-*. Thus, this constraint does not play a decisive role in the evaluation here.

The same constraint hierarchy is responsible for the correct selection of *electri[k]al*, as seen in tableau (14) below. The losers (14b,c) severely violate either *[α back][-α back] or IDENT-IO(F), these constraints being better satisfied by the winner (14a).

(14)

Input: electri{k,s}al Relevant form: electrí[s]ity	IDENT -IO(F)	IDENT -STRESS	*[αback] [-α back]
☞a. elétri[k]al	**	*	
b. elétri[s]al	**	*	*!
c. elétri[t]al	***! [t]	*	*

Here we have a question of how the proposed analysis can account for the possible word *electri[k]*. The choice between *electri/k/* and *electri/s/* should be made. The correct selection can be achieved by the multiple-input approach in a simple way. The case is exactly the same as the unsuffixed form *critic*. Thus, let us consider the unsuffixed form *critic*. The form *electri[k]* is explained in exactly the same way. Before analyzing this type of words, it is necessary to invoke the constraint in (15). This constraint, which disallows the word final syllable to be closed by nonreleased obstruents, is justified and well documented in the OT literature including Rhee (1998).[3]

(15) Word Final Nonrelease (WFN)
Word final consonants should not be released.

This kind of constraint can explain the alternations between stops on the

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[3] Rhee (1998) proposes the constraint APR(Ao) to explain word-final neutralizations by appealing to the notion of Aperture. However, this paper does not employ the theory-specific concept, Aperture; Rather, it uses a more general term, releasing.

one hand and fricative and affricates on the other hand in many languages. For example, in Korean fricatives like *s, s', h* and affricates like *c, ch, c'* are neutralized into the unreleased stop [t] in word-final position.

The constraint WFN is lowly-ranked in English because fricatives can occur in word-final position, as observed in the words like *leaf*, *leave*, *lease*, *ease*, and *cash*. Thus, this constraint can be dominated by the faithfulness constraint. Nonetheless, it plays an active role in deciding the winner in allomorphy when other constraints fail to do so, as illustrated in (16) below. Candidates (16c,d) violate IDENT-IO(F) and IDENT-STRESS, and thus are immediately ruled out. Candidate (16c) has a unfaithful segment [t] in the output, violating IDENT-IO(F). Candidate (16d), unlike the relevant form *critic*, has stress on the final syllable, not on the first one, and thus it violates IDENT-STRESS. Moreover, this candidate has an unfaithful tense vowel on the final syllable, which incurs a violation of IDENT-IO(F). Among the remaining two candidates, the winner (16a) satisfies both IDENT-IO(F) and WFN while candidate (16b) violates WFN and satisfies IDENT-IO(F).

(16)

Input: criti{k, s} Relevant form: críti[s]ism	IDENT -IO(F)	IDENT -STRESS	*[αback] [-αback]	W F N
☞a. crí.ti[k]				
b. crí .ti [s]				*!
c. crí .ti[t]	*! [t]			
d. cri.tí[k]	*! [iy]	*		

The relevant suffixed form *criti[s]ism* is selected as optimal by the same constraint hierarchy, as seen in (17). Here, the constraint WFN does not have a direct influence on the selection of the optimal output. Instead, the constraint *[αback][-αback], which prohibits the sequence of [ki], correctly chooses the winner (17a) over (17b). Candidate (17c) with [t] replacing /k/ or /s/ violates IDENT-IO(F). Other candidates, (17d,e), have stress on the second syllable rather than on the first one and therefore violate IDENT-STRESS.

(17)

Input: criti{k,s}+ ism Relevant form: críti[k]	IDENT -IO(F)	IDENT -STRESS	*[αback] [-αback]	W F N
☞a. crí.ti .[s]i.sm				
b. cr í .ti .[k]i.sm			*! [ki]	
c. cr í .t i.[t]i.sm	*! [t]			
d. cri .tí .[s]i.sm		*!		
e. cri .tí .[k]i.sm		*!	* [ki]	

As shown above, OT combined with the multiple-input approach can avoid the problems facing current mainstream OT with the single-input approach, when dealing with English allomorphy. Moreover, the former offers a simpler explanation for it than does the latter. In addition, I suspect that the lexicon-dependent OT goes well with Richness of the Base and Lexicon Optimization in that the lexicon is as rich as possible insofar as Lexicon Optimization is well observed. The lexicon contains not a single, specific UR but a set of possible inputs to allomorphy. In this sense, Richness of the Base is satisfied. Simultaneously, Lexicon Optimization is observed as well. The set of possible inputs are not arbitrary, but rather closely identical to the optimal output. One of the possible inputs is the attested surface form. As a consequence, the seemingly conflicting demands of Richness of the Base and Lexicon Optimization are well compromised in the lexicon-dependent OT.

3. Etymological residue in the lexicon

In this section I will show that the unpredictability of segments observed in some English allomorphy originates from etymology, and that the lexicon in synchronic grammar incorporating the etymological information plays an important role in deciding the optimal allomorphs among possible candidates.

Allomorphy is observed in English when stems like *fable* and *title* are followed by suffixes like *-ous* and *-ar*: ***title*** ~ ***titul****ar*; ***fable*** ~ ***fabul****ous*. According to *SPE*, the /u/-insertion phenomenon is captured by the following rule:

(18) Ø → yūw / [-cont, -voc, +cons] _____ l + VC[-seg] (*SPE*, 196)

The rule, however, cannot account for the examples like those in (19), where the inserted /u/ is not flanked by a consonant and /l/.

(19) a. tempestu̲ous (tempest+ous)
b. conspicu̲ous (no isolated base form)

And, the /u/-insertion rule cannot be invoked to explain the existence of /i/ in stems before suffixes:

(20) ab**i̲**l+ity (able); capab**i̲**l+ity (capable)

Yip (1987) proposes the /i/-insertion rule stating that the vowel /i/ can be inserted when a vowel is forced to break a CC cluster in suffixed forms.

However, Yip's /i/-insertion rule cannot apply to the words in (20) because the structural description is not met. The insertion, nonetheless, occurs in stems.

Moreover, the unpredictability of an inserted segment cannot be captured by either *SPE*'s /u/-insertion rule or Yip's /i/-insertion rule, as exemplified in (21) below. The inserted segment in related words can be either /u/ or /i/ before the same suffix *-ity* or *-ous*.

(21)	a. /u/	ingenu+ity	ingenu+ous
	b. /i/	ingenios+ity	ingeni+ous

Current mainstream OT, which assumes the input to be unrestrained and focuses on surface well-formedness, cannot not provide a principled analysis of this type of allomorphy. Postulating a specific, abstract input is not compatible with Richness of the Base and evaluating a certain vowel as optimal cannot be maintained for other cases. Nonetheless, we need to explain the allomorphy observed in (21) and the difference between (21a) and (21b). How can we account for this type of allomorphy?

Here I suggest that we can have a clue to explain the allomorphy discussed above by falling back on etymological facts. The surface distinctions result from the etymological differences:

(22)	a. /u/	ingenu+ity	Latin	ingenuitas
		ingenu+ous	Latin	ingenuus
	b. /i/	ingeni+ous	Latin	ingeniosus
		ingenios+ity	Latin	ingeniosus

Differences among unrelated words also result from the etymological differences. The words with /u/ derive from the source words containing /u/ and those with /i/ come down from the words with etymological /i/, as evidenced in (23).

(23)	a. angular	Lat. angulāris,	Lat. angulus
	titular	Lat. titulāris,	Lat. titulus
	fabulous	Lat. fabulosus,	Lat. fabulari
	tabular	Lat. fabulāris,	Lat. tabulus
	tabulate	Lat. tabulat	Lat. tabulus
	gradual	Lat. graduālis,	Lat. gradus
	graduate	Lat. graduātus,	Lat. gradus
	b. conspicuous	Lat. conspicuus (conspic+uus)	
	contiguous	Lat. contiguus (contig+uus)	

c. ability	Lat. habilitatem
able	Lat. habilem
capability	Lat. capabilatem
capable	Lat. capabilem
capacity	Lat. capacitatem
capacious	Lat. capaci-+uus

Etymological information also gives us a clue to an explanation for the suffixal allomorphy observed in *-ial* ~ *-al*, as demonstrated in (24).

(24) a. partial	Lat. partiālis
cordial	Lat. cordiālis
b. mortal	Lat. mortālis
dental	Lat. dentālis
naval	Lat. nāvālis
nocturnal	Lat. nocturnālis
pedal	Lat. pedālis

The suffixal allomorphy would not be explained by focusing on the conditioning environment and surface forms alone. The same segmental context of stems cannot be the basis of predicting a correct suffixal allomorph. On the other hand, the difference between the two sets of words in (24) can be explained by drawing on etymological information.

We can thus conclude that the allomorphy discussed above can be explained by appealing to etymological information. This conclusion implies the preference of deletion approach over insertion approach in derivational terms. A problem remains with the etymology-based explanation, though. It is generally accepted in the generative tradition that synchronic grammar has no direct access to etymology. Then, how can we reflect etymological information in synchronic grammar? The most promising way is to store some portion of the information in the lexicon, which is crucial part of synchronic grammar. The lexicon should contain at least unpredictable and indispensable information for a morpheme.

Let us now turn to an analysis of the allomorphy in question within the framework of lexicon-dependent OT. By way of illustration, I will examine two pairs *able* ~ *ability* and *angle* ~ *angular*. We need to introduce relevant constraints, first. IDENT-IO and IDENT-STRESS have already been adduced. Here, the ranking between IDENT-IO and IDENT-STRESS is justified: IDENT-IO >> IDENT-STRESS.

(25)

Input: ab/i/l+ity Relevant form: áble	IDENT-IO(F)	IDENT-STRESS
☞a. a.bí.li.ty	**	*
b. á.bu.li.ty	***! (u)	

In addition to these two constraints, several more constraints are relevant here. First, the constraint MAX-IO, defined in (26), plays an active role in explaining the allomorphy discussed above.

(26) MAX-IO: Every segment of the input has a correspondent in the output.

The constraint MAX-IO should dominates IDENT-IO(F), as evidenced in tableau (27). Candidates (27a,b) violate all IDENT-IO(F) due to schwas.

(27)

Input: ab/i/l+ity Relevant form: áble	MAX-IO	IDENT-IO(F)	IDENT-STRESS
☞a. a.bí.li.ty		**	*
b. áb.li.ty	*!	*	

The constraint ranking, MAX-IO >> IDENT-IO(F) >> IDENT-STRESS, is responsible for the correct selection of the surface form *ability* as optimal. Candidate (28c) violates IDENT-IO more severely than (28a), due to the inserted vowel [u] in addition to two schwas.

(28)

Input: ab/i/l+ity Relevant form: áble	MAX-IO	IDENT-IO(F)	IDENT-STRESS
☞a. a.bí.li.ty		**	*
b. áb.li.ty	*!	*	
c. a.bú.li.ty		***! [u]	

Now we need another constraint to explain the unsuffixed form *able*. The lexical form /eybil/ surfaces changed: The segment /i/ is omitted in the surface form. This mismatch between input and output is forced by a constraint *∂C[+son] defined in (29).

(29) *∂C[+son]: Moraless schwa should not be followed by non-syllabic sonorants.

This constraint is responsible for the occurrence of syllabic sonorants and schwa deletion:

(30)

Input: eyb/i/l Relevant form: abílity	*∂C[+son]	MAX -IO	IDENT -IO(F)	IDENT -STRESS
☞a. (éy.)bl̩		*		*
b. (éy)b∂l	*!		*	

The constraint hierarchy motivated above is also responsible for the correct selection of *angle* over *angul*.

(31)

Input: ang/yu/l Relevant form: ángular	*∂C[+son]	MAX -IO	IDENT -IO(F)	IDENT -STRESS
☞a. án. gl̩		*		*
b. án.gy∂l	*!		*	
c. án.g∂l	*!	*	*	

The suffixed form *angular* is explained in the same way as the unsuffixed form *angle* with an addition of two more constraints, as illustrated in (32). One is *GEMMINATE, which prohibits a sequence of the identical or almost identical segments: *ll, *lr, *rl, and *rr, etc. The other constraint is the constraint OCP-[liquid], which prohibits the occurrence of two tokens of liquids in the domain of syllable: *lVl and *rVr.[4] I assume for now that *GEMMINATE is undominated in English, and that the constraint OCP-[liquid] is dominated by IDENT-IO(F), thus making it possible for such underived forms as *rear* and *rare*, which contain no allomorphs to choose, to surface unscathed.

(32)

Input: ang/yu/l+a{r, l} Relevant form: ángle	*GEM	*∂C[+son]	MAX -IO	IDENT -IO(F)	IDENT- STRESS	OCP- [liquid]
☞a. án.gyu.lar		*		*		
b. án.gyu.lal		*		*		*!
c. án.glar		*	*!	*		
d. án.glal		*	*!	*		
e. án.gyi.lar		*		**! [i]		
f. án.gyu.ll	*!					
g. án.gi.lr	*!					

In sum, the allomorphy related to vowels /i/ and /u/ can be explained in a straightforward way within OT by drawing on the lexicon containing unpredictable etymological information. The lexicon-dependent OT reduces

4 The two constraints *GEMMINATE and OCP-[liquid] can be collapsed into a single constraint, which in turn can be covered by the broad constraint OCP. I leave this issue unsettled in this paper since it does not affect the main point discussed here.

the unpredictability and indeterminacy in output well-formedness. The lexicon-sensitive OT can extend from segmental allomorphy to suprasegmental aspects of English phonology.

4. Stress-marking in the lexicon

In this section I will address the unpredictability of stress patterns for the same types of words in terms of grammatical category and/or segmental structure and then show that the lexical information should be accessed in evaluation of output well-formedness.

Let us first address the stress pattern of English adjectives with the same segmental make-up. Traditionally, unsuffixed adjectives are grouped with verbs in regard to stress pattern while suffixed adjectives are with nouns. However, Lee (1996) proposes that unsuffixed adjectives can be grouped into two stress types: the one patterning with nouns and the other with verbs.

(33) Heavy ultimate syllables
  a. hónest, módern, stúbborn (Nominal pattern)
  b. divíne, compléte, seréne, sincére (Verbal pattern)

The words in (33a) have stress on the first syllable, while the words in (33b) attract stress on the final syllable. Regardless of acceptance of Lee's (1996) proposal, it is noteworthy here that the difference between (33a) and (33b) cannot be predicted on the basis of grammatical category and segmental/syllable make-up.

The unpredictable stress pattern of the words with grammatical and segmental identity is also observed in considering the place names:

(34) Light penultimate syllables
  a. América, Cánada (Antepenultimate stress)
  b. Mississíppi, Kentúcky (Penultimate stress)

The words in (34a) show that stress falls on the antepenult skipping over the light penult, while the words in (34b) have stress on the light penult. The stress distribution cannot be explained in a unified way on the base of a single grammatical mechanism within the framework of OT without recourse to lexical information on stress.

The third example of unpredictable stress patterns of words with identical grammatical and segmental/syllable make-up comes from the trisyllabic words ending with a heavy syllable. It is not predicted in a straight-forward way whether the heavy final syllables can attract a stress or not.

The words in (35a) below do not have stress on the heavy ultimate syllable while the words in (35b) have stress on the heavy ultimate syllable.

(35) Heavy ultimate syllables
a. cálibou, búffalo, cálico, Málibu
b. chimpanzée, referée, macaróon, enginéer

What formal phonological mechanism can cover these three kinds of unpredictability about English stress patterns? As an answer to this question, I propose that the three kinds of unpredictability can be explained in a consistent and uniform way by resorting to lexical information on stress. I follow Hammond (1999), Burzio (2000) and Pater (2000) in assuming that grammatically unpredictable stress is marked in lexical forms. I assume here that the unmarked stress pattern of adjectives, regardless of derivedness, follows the nominal stress pattern showing a two-or three-syllable window from a word-end, and thus that the adjectives like *divíne* and *extréme* are lexically stress-marked. As for the place names, I assume that nouns like *Mississíppi* and *Kentúcky* have lexical stress markings. Last, the trisyllabic words like *chimpanzée* and *referéfe* are assumed to be lexically marked for stress.

OT without appealing to lexical information has difficulty in picking up the optimal candidate among competing output candidates. For example, the two possible candidates *se.(ríy)n* and *(sé.re)n* both satisfy FT-BIN(μ), NONFIN, and ALIGN(Ft, R, PrWd, R), all of which play a crucial role in choosing the optimal metrical structure in English.[5] And, the foot parsing of *(sé.re)n* is better than that of *se.(ríy)n* in terms of PARSE-σ: The constraint PARSE-σ would wrongly select *(sé.re)n* as the winner in the evaluation of *(sé.re)n* vs. *se.(ríy)n*. Thus, the stress placement of the unsuffixed form *ser[íy]ne* is incorrectly predicted by grammar within the framework of OT without recourse to the lexicon. Thus, it is reasonable to assume that the stress on the final syllable of *serene* is lexically marked.

I will illustrate what the analysis proposed here looks like, by examining the word *serene*. The constraint ranking, IDENT-IO(F), IDENT-STRESS >> Parse-σ, FT-BIN(μ), is responsible for the correct selection of the optimal output, as seen in (36).

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5 These constraints are well motivated in the OT literature and thus are given no definitions here.

(36)

Input: ser{iy, e}n Lexical stress: CVCV′ C	IDENT -IO(F)	IDENT -STRESS	Parse-σ	FT-BIN(μ)
☞a. se.(ríy)n	*		*	
b. se.(ré)n	*		*	*!
c. (sé.re)n	*	*!		
d. (síy.)ren	**! [/iy/]	*	*	
e. se.(rə́y)n	**! [ay]		*	

Candidates (36d,e) severely violate IDENT-IO(F) because they do not show the identical vocalic quality between input and output. Therefore, these candidates are immediately excluded from the evaluation. On the other hand, candidates (36a,b) equally violate the constraint in that input vowels become schwa in unstressed position but remain intact in stressed position. As for the next lower constraint Parse-σ, candidates (36a,b) are tied since they have one syllable unparsed. The competition between these two candidates finishes when they are evaluated against FT-BIN(μ). The ranking between IDENT-STRESS and Parse-σ is crucial to choose candidate (36a) over candidate (36c). The winner (36a) satisfies IDENT-STRESS and violates Parse-σ, while (36c) violates IDENT-STRESS and satisfies Parse-σ. Notice here that the prosodic faithfulness constraint IDENT-STRESS applies to the correspondence between lexical and surface stress.

Justification for the constraint ranking is confirmed by another tableau (37), which shows the correct selection of the suffixed form *se.(ré . ni.) ty*.

(37)

Input: ser{iy, e}n + ity Relevant form: se.ríy.n	IDENT -IO(F)	IDENT -STRESS	Parse- σ	FT- BIN(μ)
☞a. se(ré.ni.)ty	**		**	
b. se.(ríy).ni.ty	**		***!	
c. se.(ríy.ni.)ty	**		**	*!

All candidates in (37) violate IDENT-IO(F) and satisfy IDENT-STRESS equally. The second syllable of the suffixed form is in prosodic correspondence with the corresponding syllable of the related unsuffixed form *se.(ríy)n*. A possible candidate (sè.re.) (ní.ty), which shows that all syllables are parsed and primary stress is placed on the penult, violates IDENT-STRESS and NONFIN, and thus it is ruled out of the competition. Candidates (37a,b) being evaluated against Parse-σ, (36b) is rejected as suboptimal. Last, of the two candidates (37a) and (37c), the former is selected as the winner since it better satisfies the constraint FT-BIN(μ) than the competitor (36c) with a trimoraic foot.

As discussed in this section, English shows several kinds of unpredictable stress patterns. It was shown here that the unpredictability can be explained a uniform way in OT relying on the lexical stress marking, and that the lexicon-dependent OT can extend from segmental allomorphy to the area of stress where output-oriented OT initiated its enterprise and has had the most success over the input-to-output derivational model.

5. Conclusion

I have argued in this paper that lexical information should be highly valued even in OT which focuses its concern on output well-formedness, and that the lexicon-dependent approach proposed here can explain English allomorphy and unpredictable stress patterns in an explanatory and simpler way within the framework of OT. Dependence of the lexicon leads to a correct selection of output well-formedness on the one hand and minimizes the unpredictability and indeterminacy of surface forms on the other. Specifically, it was argued in this paper that the well-known phenomenon of Velar Softening is accounted for in a straightforward and explanatory way by falling back on the multiple-input approach couched in OT. The allomorphy relating to the vowels /i/ and /u/ was also shown to go to a direct explanation within the framework of OT depending on the lexicon. In addition to segmental allomorphy, unpredictable stress patterns were explained in a consistent and uniform way by having access to lexical stress markings.

I have also shown that the multiple-input approach represented by Morpheme Alternant Theory goes well with OT in explaining English allomorphy. The lexicon-dependent approach to allomorphy allows the lexicon not to be restricted by the input-uniquness principle and thus does not conflict with Richness of the Base in some sense. This approach also harmonizes with Lexicon Optimization in a sense that outputs are not arbitrary but transparently corresponding to inputs. In this respect, this lexicon-dependent approach resolves the conflicting demands of Richness of the Base and Lexicon Optimization and thus broadens the horizon of OT.

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