On phonological opacity in English word stress

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Cho, Hyeonkwan. 2001. On phonological opacity in English word stress. *Studies in Phonetics, Phonology, Morphology* 7.2. 423-448. In English, regardless of the status of syntactic categorization, word stress falls on long vowels and diphthongs in monomorphemic words. However, English stress assignment shows two types of non-surface-true phonological opacity. In many words which contain a long vowel or a diphthong, stress apparently does not fall on those vowels. In this paper, after comparing constraint-based approaches to resolve opacity problems, I show that an extended version of output-to-output correspondence and detailed distinction of vowel quality give a better account of the two cases of phonological opacity in English word stress. (**Chungnam National University**)

Keywords: opacity, word stress, output-to-output correspondence, Optimality Theory, Sympathy Theory

1. Introduction

Optimality Theory (Prince & Smolensky 1993) differs from derivational phonological theories in that it does not allow serial derivations. The output-based Optimality Theory is based on parallel implementation. The relationship between inputs and outputs is defined as a direct correspondence or mapping. Optimality Theory does not allow any intermediate levels or representations. Constraints in standard Optimality Theory are categorized into two groups. Faithfulness constraints refer to both inputs and outputs and penalize any possible candidates that undergo some phonological changes from their corresponding input forms. In contrast, well-formedness constraints are totally output-based since they never refer to input forms in evaluating output candidates. They penalize output candidates that do not conform to the surface generalization of the language.

With all the advantages over traditional rule-based phonological theories, Optimality Theory faces a serious problem caused by phonological opacity phenomena. Kiparsky (1973) introduced the notion of phonological opacity in traditional generative phonology, as follows. The first type of opacity is found in non-surface-true output forms caused by underapplication of a phonological rule whereas the other type of opacity is found in non-surface apparent output forms caused by overapplication of a phonological rule.

(1) opacityc

A phonological rule *P* of the form $A \rightarrow B / C\_\_D$ is opaque if there are surface structures with any of the following characteristics:

a. instances of *A* in the environment $C\_\_D$.

b. instances of *B* derived by *P* that occur in environments other than $C\_\_D$.

Since McCarthy (1995) first brought up this problem, a lot of different approaches to opacity have been proposed. McCarthy (1995) and Cole and Kisseberth (1995) adopt input-output well-formedess constraints. Ito and Mester(1999) argue for mutli-stratum to allow serial evaluation. McCarthy (1998) proposes Sympathy Theory that in a sense allows double inputs to select an optimal output. However, all these works give up some principles of standard Optimality Theory. Input-output well-formedness constraints imply a serious deviation since they incorporate structural description of input forms, as rule-based theories do. Multi-stratal approach with serial evaluation should allow intermediate levels and give up the core principle of direct input-output correspondence. Sympathy Theory raises a problem with positing sympathetic candidates that are non-existing in the real world. As we will see in the next section, rule-based phonological theories, employing rule ordering, appear to fare better in accounting for phonological opacity than constraint-based Optimality Theory does. Thus, Phonological opacity is a potentially challenging problem to be resolved in some ways.

In English, most words observe Weight-to-Stress Principle since long vowels are stressed. However, Weight-to-Stress Principle is opaque in a lot of words such as *alien, mania, various, Mary, city, broccoli,* and so on since lengthened vowels do not attract stress in these words, for example [éɪliən] 'alien' and [mɛ́ri] 'Mary'. To deal with opacity in English word stress, I adopt output-output correspondence (McCarthy & Prince 1995 and Benua 1995) and phonetic distinction of vowel quality.

The organization of this paper is as follows. Section 2 reviews a derivational approach and a constraint-based approach to phonological opacity. I show typical cases of non-surface-true opacity and non-surface-apparent opacity. I examine problems with dealing with both types of opacity in standard Optimality Theory. In section 3, non-surface-true opacity in English word stress assignment is introduced and analyzed. I show that the opacity of English stress assignment cannot be adequately handled in the tenet of standard Optimality Theory. In section 4, I illustrate and compare three different approaches to opacity in English word stress. Section 5 provides an alternative account of opacity. I argue that output-to-output correspondence gives a better account of stressless prevocalic tense vowels and phonetic distinction must be required to account for stressless tense vowels in the word-final position. Section 6 concludes the paper.

2. Phonological opacity

According to McCarthy (1998), there are generally two types of phonological opacity. Non-surface-true opacity occurs if a form fails to undergo a process even though its surface form matches its structural description. Non-surface-apparent opacity occurs if a form undergoes a process although it fails to match structural description of the process.

An interesting example of non-surface-true opacity comes from interaction between English vowel lengthening and intervocalic flapping. As is discussed by Shane (1973), English vowels, whether monophthongs or diphthongs, are lengthened before voiced consonants. Comparing vowel length in the words like *bead, bag, ride* and *beat, back, write,* the vowel before a voiced consonant is phonetically longer than before a voiceless one. Intervocalic flapping converts intervocalic *t* and *d* to flap *D*. as in *rider* and *writer*. The flap sound phonetically is a voiced segment. English dialects vary in the length of the vowel when *writer* is pronounced. Phonological opacity takes place when there is no vowel lengthening. Vowel lengthening fails to apply even though [rayDər] matches its structural description. Why the diphthong is not lengthened before a voiced [D] must be explained.

Traditional generative frameworks definitely show advantages over output-oriented Optimality Theory in accounting for the dialectal variation in vowel length because phonological rules are freely ordered, as follows.

(2) a. opacity of vowel lengthening

underlying form	:	/raytər /	'writer'
vowel lengthening	:	----	
intervocalic flapping	:	rayDər	
surface form	:	[rayDər]	

b. transparency of vowel lengthening

underlying form	:	/raytər /	'writer'
intervocalic flapping	:	rayDər	
vowel lengthening	:	ra:yDər	
surface form	:	[ra:yDər]	

The surface form [rayDər] is opaque since the vowel [ay] fails to undergo lengthening whereas the form [ra:yDər] is transparent since the vowel is lengthened before voiced [D]. Rule ordering between vowel lengthening and intervocalic flapping accounts for both forms, [rayDər] and [ra:yDər].

Let us consider the dialectal variation caused by interaction of vowel lengthening and flapping in standard Optimality Theory. I employ *VtV to prohibit an intervocalic *t* which is preceded by a stressed vowel, and *ShortV-VoicedC to disallow a sequence of a short vowel followed by a voiced consonant.[1] NoFlap prevents a flap and Dep-IO(V) militates against vowel lengthening. *VtV ranks over NoFlap since NoFlap is violated to satisfy *VtV. *ShortV-VoicedV ranks over Dep-IO(V) since Dep-IO(V) is forced to be violated to satisfy *ShortV-VoicedC.

(3) a. intervocalic *t*-flapping: *VtV » NoFlap
b. vowel lengthening: *ShortV-VoicedC » Dep-IO(V)
c. ranking: *VtV, *ShortV-VoicedC » NoFlap, Dep-IO(V)

*VtV and *ShortV-VoicedC never conflict, and cannot be ranked with respect to one another. Let us look at the following constraint tableau to see how the constraints interact when the input is *writer* /raytər/.

(4)

/raytər/	*VtV	*ShortV-VoicedC	NoFlap	Dep-IO(V)
raytər	*!			
ra:ytər	*!			*
rayDər		*!	*	
☞ ray:Dər			*	*

The last candidate [ray:Dər] violates lower-ranked constraints, NoFlap and Dep-IO(V) while other candidates have fatal violation of higher-ranked constraints. Thus, the optimal output turns out to be [ray:Dər] which undergoes both vowel lengthening and flapping.

However, in some dialects of English, the third candidate [rayDər] is the actual pronunciation of the word *write*, as in (2a). The intervocalic stop undergoes flapping, but the short diphthong before a voiced flap is not lengthened. In other words, the vowel lengthening is opaque. Obviously, the constraint ranking in (3) is not able to select [rayDər] as the optimal output, and there is no other possible constraint ranking that accounts for

[1] I group both monophthongs and diphthongs into 'short vowels' in the sense that they are not lengthened. It is not clear that a lengthened diphthong has two moras or three moras. So, I assume that vowel lengthening and augmentation violate Dep-IO(V), rather than Dep-IO(mora).

[rayDər]. Dep-IO(V) should always be lower-ranked because 'rider' is pronounced as [ray:Dər] in the same dialects.

It is evident that the standard Optimality Theory is not able to handle non-surface-true opacity of English vowel lengthening. Surface-apparent opacity also would not be solved in the standard theory. I will briefly discuss non-surface-apparent opacity that occurs in Korean. Tak (1997) examines the interaction of post-obstruent tensification and consonant cluster simplification. In most Korean dialects, post-obstruent stops are tensified, as in /ip-ko/ [ip-k'o] 'wearing'. In Kyungsang dialect, /ilk-/ 'to read' and /malk-/ 'clean' are simplified to [il-] and [mal-], respectively. We can expect that post-obstruent tensification would not apply when the final stop in /malk-/ is deleted by cluster simplification. However, as shown below, the suffix-initial stop undergoes tensification.

(5) opacity of post-obstruent tensification

underlying form	:	/malk-ta/	'to be clean'
post-obstruent tensification	:	malkt'a	
cluster simplification	:	malt'a	
surface form	:	[malt'a]	

The actual output form [malt'a] shows that it undergoes tensification although it fails to match structural description on the surface level. Output-based Optimality Theory cannot handle the opacity of tensification. We can predict that constraint ranking for Kyungsang dialect wrongly selects [malta] as the optimal form.

So far, I have shown that two types of opacity found in English and Korean are problematic in output-oriented standard Optimality Theory. It is desirable to provide a coherent and systematic solution to any type of opacity. However, the current works in the tenet of Optimality Theory do not seem to provide a unified account of opacity. For now, it would be a better idea to give separate solutions to various cases that show opacity effects. In this vein, I will give different solutions to two cases of opacity found in English stress assignment.

3. English word stress

3.1 A basic analysis

Before touching upon the issue of stressless long vowels, I review general principles of stress assignment in English monomorphemic words. English stress patterns are murky in a sense that a single constraint ranking cannot explain them. Setting up a total constraint ranking for English stress system is beyond the scope of this paper. So, I focus on the very general pattern of English nouns, verbs, and adjectives. The following data of English nouns, verbs, and adjectives are from Hogg and McCully (1987), Hammond (1999), and others.

(6) a. nouns

desígn	ellípsis	muséum	polýgamy
ballóon	inspéctor	aróma	élephant
fillét	propagánda	flúid	América
bambóo	veránda	stúpid	cínema

b. verbs

erás e	collápse	devélop
evád e	tormént	édit
maintáin	exíst	astonish

c. adjectives

supréme	absúrd	cómmon
obscéne	corrúpt	sólid
compléte	robúst	frántic

As is well known, there are several characteristics of English stress patterns. Every content word has word stress, especially, a main stress. The main stress tends to fall on near the right edge of a word, although rightmost syllables tend not to attract it, for example, *abracadábra, hamamelidánthemum*. English generally is a quantity-sensitive language because heavy syllables tend to attract stresses. Word stress is assigned to any syllable that contains a long vowel in all lexical categories, for example, *desígn, maintáin, supréme*.

English shows slightly different stress patterns in nouns and verbs when there is no syllable with long vowels in a word. Nouns show that the penultimate syllable is stressed if it is heavy syllables that are closed a single consonant, for example, *ellipsis*, and the antepenultimate syllable is assigned main stress if both final and penultimate syllables are light, for example, *América*. On the other hand, both verbs and adjectives show that the final syllable is assigned word stress if it is closed by two consonants, for example, *collápse*, *absúrd*. This is not the case in nouns as in *bálance, hárvest, tríumph*. If the final syllable of verbs and adjectives is closed by a single consonant, it does not attract stress, rather the preceding penultimate syllable receives main stress, for example, *astónish, cómmon*.

Constraint-based Optimality Theory explains English stress assignment by interaction of prosodic constraints. I introduce some fundamental prosodic constraints that are well-established in the current literature. I restrict my discussion to noun stress assignment since the opacity problem of stress I will bring up might have almost identical treatment in all lexical categories. Note that the list of the following constraints is not exhaustive, though.

(7) prosodic constraints
Rooting : All content words are stressed.
Parse-σ: Syllable must be footed
FootBinarity : Feet are binary at some level of analysis (μ, σ).
Align-R : All feet are aligned with the right edge of the word.
Trochee: The stress occurs on the left side of the foot.
NonFinality(foot) : The final syllable is not footed.
NonFinality(head) : The final syllable is not the head of a foot.
Weight-to-Stress Principle[2]
WSP(VV) : Heavy syllable (VV) must be stressed.
WSP(VCC) : Heavy syllable (VCC) must be stressed.
WSP(VC) : Heavy syllable (VC) must be stressed.

Rooting, Trochee, and WSP(VV) are undominated since they are never violated, as shown in (6). Here, VV stands for both tense vowels and diphthongs in that they are longer. I put FootBinarity over NonFinality. NonFinality is forced to be violated to satisfy FootBinarity. For example, the foot structure of *city* is (*cíty*), not (*cí*)*ty*.[3] Parse-σ is ranked higher than Align-R in nouns while the ranking between them is reversed in verbs and adjectives. NonFinality outranks Align-R since *cinema* has the foot structure, (*cíne*)*ma*, rather than *ci*(*néma*). Parse-σ ranks over Align-R since *A*(*méri*)*ca* rather than (*Áme*)*rica* is the right one.

(8) Rooting
Trochee » FootBinarity » NonFinality » Parse-σ » Align-R
WSP(VV)

Nouns and verbs differ in the ranking of parameterized WSP constraints. WSP(VCC) and WSP(VC) are just below NonFinality in nouns. If the final syllable is VCC or VC, stress does not fall on it like *bálance* and *ellípsis*. Contrastingly, WSP(VCC) is top-ranked in verbs since the final VCC is stressed as in *collápse* whereas WSP(VC) is could be ranked lower since *develop* is not footed as *deve*(*lóp*). The total constraint ranking for

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[2] I follow Hammond's (1999) view on Weight-to-Stress Principle. He proposes a universal ranking of parameterized WSP constraints. It is plausible that the degree of syllable weight can differentiate the degree of stress attraction as long as that is what happens in English stress system.

[3] Although I do not provide an argument in detail, there are different ways in order to satisfy FootBinarity. The intervocalic consonant of *city* may be syllabified as a coda of the preceding syllable like (cit)y, or it may be ambisyllabic.

English noun stress should be more elaborated, but in this paper I confine my discussion to the basic data given above. The following constraint tableaux show how prosodic constraints interact and select optimal outputs. Less important candidates are not included to save the space. Trochee and Rooting also are not included for the same purpose. So, note that each foot structure illustrated in the tableaux is trochaic.

(9) nouns

	W(VV)	FB	NFh	NFf	W(VC)	Pσ	AR
☞ dɪ(zaɪn)			*	*		*	
(dɪzaɪn)	*!			*			
(dɪ)zaɪn	*!	*				*	*
(dɪ)(zaɪn)		*!	*	*			*
☞ ɪ(lɪp)sɪs					*	**	*
ɪ(lɪp)(sɪs)			*!	*		*	*
ɪ(lɪpsɪs)				*!	*	*	
(ɪlɪp)sɪs					*!*	*	*
(ɪ)(lɪp)(sɪs)		*!	*	*			***
☞ mjʊ(zi:)əm					*	**	*
mjʊ(zi:əm)				*!	*	*	
(mjʊzi:)əm	*!				*	*	*
mjʊ(zi:)(əm)			*!	*		*	*
☞ ə(mɛrɪ)kə						**	*
əmɛ(rɪkə)				*!		**	
(əmɛ)rɪkə						**	*!*
(əmɛ)(rɪkə)				*!			**
(ə)(mɛrɪ)kə		*!				*	****

The optimal output *dɪ(zaɪn)* violates relatively lower-ranked NonFinality whereas the second and the third candidates have fatal violation of the higher-ranked WSP(VV). The candidate *(dɪ)(zaɪn)* violates another higher-ranked FootBinarity. WSP(VC) plays a crucial role in selecting out *ɪ(lɪp)sɪs* as the optimal one. The most competing *(ɪlɪp)sɪs* violates WSP (VC) twice whereas *ɪ(lɪp)sɪs* violates it once. The optimal *mjʊ(zi:)əm* that violates WSP(VC) is more harmonic because other candidates violate one of the higher-ranked constraints. Lower-ranked Align-R is important in selecting *ə(mɛrɪ)kə* as optimal. The competing candidate *(əmɛ)rɪkə* is worse since it violates Align-R twice.

3.2 Opacity of Weight-to-Stress

In this section I discuss two cases of opacity phenomena that occur in English stress system. As we have seen in the previous section, WSP(VV) seems to be undominated since long vowels attract stress in English. However, it is not surface-true since long vowels on the surface are stressless in a lot of words. According to Hogg & McCully (1987), the word *alien* is pronounced [éɪliən] in some dialects and [éɪlɪən] in other dialects.[4] We know that [éɪlɪən] agrees with the general pattern of English word stress. Hogg and McCully argue that the penultimate vowel that is underlyingly short is lengthened by prevocalic vowel lengthening of non-low vowels. So, the underlying /eɪlɪən/ becomes [eɪliən] on the surface. However, [éɪliən] that does not follow the general stress pattern since the medial long (tense) vowel does not attract stress. Hammond (1999) gives more words that show stressless word-medial long vowels.

(10) stressless word-medial long vowels

[i]	álien	mánia	várious
[u]	árduous	ánnual	génuine
[e]	Hébraism	árchaism	Júdaism
[o]	héroin	bénzoin	jíngoism

It is clear that stress assignment is opaque since the medial long vowels on the surface do not receive stress. The opacity of stress assignment can be accounted for by traditional rule-based theories through rule ordering. That is, stress assignment is carried out at the level of underlying representation, and prevocalic vowel lengthening applies after stress assignment. On the other hand, stress assignment is transparent in dialects where [éɪlɪən] is the actual pronunciation since there is no prevocalic vowel lengthening in those dialects.

(11) opacity of stress assignment.

underlying form	:	/eɪlɪən/	'alien'
stress assignment	:	éɪlɪən	
prevocalic lengthening	:	éɪliən	
surface form	:	[éɪliən]	

[4] They note that American English shows such dialectal variation though they do not name specific dialects, whereas its usual pronunciation in British English is either [éɪlɪən] or [éɪljən].

This type of non-surface-true opacity is problematic in standard Optimality Theory since all well-formedness constraints are output-based. Well-formedness constraints are not allowed to refer to input forms. Let's see how the constraint ranking employed for English stress deals with opacity. We need a sequential constraint that prohibits a non-low short (lax) vowel followed by another vowel such as *ShortV-V. We can predict this constraint is ranked higher in dialects where speakers pronounce *alien* as [éɪliən] whereas it is low-ranked in dialects where [éɪlɪən] is the speakers' pronunciation. The following constraint tableaux show how the general constraint ranking for English stress select optimal outputs.[5]

(12) a. Dialect A: [éɪlɪən]

/eɪlɪən /	W(VV)	FB	NFh	NFf	W(VC)	Pσ	AR	*SVV
☞ (eɪlɪ)ən					*	*	*	*
eɪ(lɪən)	*!			*	*	*		*
(eɪ)lɪən					*	*!*	**	*
eɪ(lɪ)ən	*!	*			*	**	*	*
eɪlɪ(ən)	*!		*	*		**		*
(eɪ)(lɪən)				*!	*		**	*
(eɪlɪ)(ən)			*!	*			*	*
(eɪ)(lɪ)(ən)		*!	*	*			***	*

b. Dialect B: [éɪliən]

/eɪlɪən /	W(VV)	*SVV	FB	NFh	NFf	W(VC)	Pσ	AR
(eɪli)ən	*!					*	*	*
eɪ(liən)	*!				*	*	*	
(eɪ)liən	*!					*	**	**
eɪ(li)ən	*!					*	**	*
eɪli(ən)	*!*			*	*		**	
☹ (eɪ)(liən)					*	*		**
(eɪli)(ən)	*!			*	*			*
(eɪ)(li)(ən)				*!	*			***

[5] In the first tableau I do not include candidates that undergo prevocalic vowel lengthening since they are to violate higher-ranked faithfulness constraint like Max-IO(mora). The optimal candidate tolerates the violation of *ShortV-V since the constraint is so low. In the second tableau, candidates that do not undergo prevocalic vowel lengthening are not illustrated since they would have fatal violation of higher-ranked *ShortV-V.

The first tableau shows that stress assignment is transparent in that the optimal output *(eɪlɪ)ən* is selected by the general constraint ranking. However, in the second tableau, the output *(eɪ)(liən)* is wrongly selected out as the optimal one, although the actual pronunciation for is *alien* is *(eɪli)ən* as shown in the first candidate. The candidate *(eɪli)ən* violates higher-ranked WSP(VV), but (eɪ)(liən) violates lower-ranked constraints.

This result does not imply that WSP(VV) should be demoted in Dialect B since *muséum, aróma, flúid, stúpid* show that stress falls on the word-medial long vowel, as shown in (9). These words have underlying long vowels in the medial position. In order to account for stress assignment of *museum*, I add more candidates in the following tableau and see how the actual output is selected as the optimal output.

(13)

/mjuziəm /	W(VV)	*SVV	FB	NFh	NFf	W(VC)	Pσ	AR
(mjuzi)əm	*!					*	*	*
mju(ziəm)	*!				*	*	*	
(mju)ziəm	*!					*	**	**
mju(zi)əm	*!					*	**	*
mjuzi(əm)	*!*			*	*		**	
☞(mju)(ziəm)					*	*		**
(mjuzi)(əm)	*!			*	*			*
(mju)(zi)(əm)				*!	*			***

There is no problem with selecting the optimal output *(mju)(ziəm)* with the given constraint ranking. The medial prevocalic vowel is underlyingly long vowel and it attracts stress. The first candidate loses out to the optimal one since it fatally violates top-ranked WSP(VV). The last candidate is the most competing, but it also has a fatal violation of NonFinality(head). Therefore, it is evident that stress assignment of the words in (10) shows non-surface-true opacity and, as shown in (12b), it cannot be handled with constraint ranking of standard Optimality Theory.

Let us move on to another opacity effect in English stress system. As Hogg & McCully note, speakers pronounce the pair *Mary* and *Marie* differently. *Maríe* always has final long vowel [i] and many speakers have a final long vowel [i] for *Máry*, too. Note that in the case of *Marie* the underlying final vowel is /i/ whereas it is /ɪ/ for *Mary*. In many dialects of English, word-final non-low vowels undergo vowel lengthening. Then stress would fall on the last syllable. We have to account for why the final long vowel of *Mary* is not stressed. This is another case of non-surface-true opacity of stress assignment. The following two groups of words show that they differ in underlying length of the final vowels. They are from Hammond (1999) and Hogg & McCully (1987).

(14) a. stressed word-final long vowels

Maríe	blasé	agrée
Ballyhóo	okáy	crochét
shampóo	outré	eschéw
goatée	risqué	sauté

b. stressless word-final long vowels

Máry	cíty	cándy	bróccoli	macaróni
jujítsu	Kikúyu	kínkajou		

As a matter of fact, there are thousands of words that end with underlying /ɪ/. We see that there could be no problem with putting stress on the final long vowel of *Marie*. Stress assignment applies to the underlying form, which in turn undergoes word-final vowel lengthening.

(15) opacity of stress assignment

underlying form	:	/mɛrɪ/	'Mary'
stress assignment	:	mɛ́rɪ	
final lengthening	:	mɛ́ri	
surface form	:	[mɛ́ri]	

Standard Optimality Theory that is equipped with output-based well-formedness constraints is not able to handle this non-surface-true opacity. *ShortV# will be used as a sequential constraint that disallows a short vowel in the word-final position. This constraint must be top-ranked in dialects where speakers lengthen final short vowels. The following constraint tableau shows constraint ranking for English stress cannot select [mɛ́ri] as the optimal output. Furthermore, any reranking of the constraints faces the same problem.

(16) 'Mary'

/mɛrɪ/	W(VV)	*SV#	FB	NFh	NFf	W(VC)	Pσ	AR
(mɛrɪ)		*!			*			
(mɛ)rɪ		*!	*				*	*
mɛ(rɪ)		*!	*	*	*		*	
(mɛri)	*!				*			
(mɛ)ri	*!		*				*	*
☹ mɛ(ri)				*	*		*	
(mɛ)(ri)			*!	*	*			*

Interaction of the constraints wrongly predicts that the candidate *mɛ(ri)* would be optimal, although the actual output is *(mɛ́ri)*, which is the fourth candidate. The candidate *(mɛ́ri)* loses out to *mɛ(ri)* since it fatally violates violates top-ranked WSP(VV). The final long vowel of the candidate is not stressed. The candidate mɛ(ri) satisfies WSP(VV) and violates relatively low constraints such as NonFinality(head), NonFinality(foot), and Parse-σ. In contrast, we can predict Maríe *mɛ(ri)* is selected as the optimal output without any problem by the same constraint ranking.

So far, I have shown two types of opacity in English stress system. They all are rather accounted for by rule ordering of rule-based theories. However, they are problematic in output-based Optimality Theory. The crucial point is that rule-based theories allow intermediate levels since they are based on serial derivation while output-based Optimality Theory does not allow intermediate levels since it is based on parallel mapping of the input to the output. Within the framework of Optimality Theory, there have been various arguments and proposals in order to resolve problems caused by opacity. Unfortunately, the result is not successful in that most works force us to cast away some basic principles of Optimality Theory, which have been regarded as advantages over rule-based theories. Various approaches to opacity are compared in the next section.

4. Approaches to opacity

4.1. IO well-formedness

One possible approach to opacity modifies the function of output-based well-formedness constraints. In standard Optimality Theory, faithfulness constraints can refer to the input and output simultaneously. They penalize any change from the input form whereas well-formedness constraints have access to the output only. The mechanism automatically instantiates direct mapping of inputs to outputs and avoids intermediate levels. By letting some well-formedness constraints refer to input and output, opacity can be resolved while preserving direct mapping of input to output. Hammond (1999), Orgun (1995), and Archangeli and Suzuki (1997) employ this type of constraints.

Let us discuss how the opacity of English stress assignment is handled with IO well-formedness constraints. To resolve opacity of stress, the constraint WSP must be redefined to refer to input vowels.

(17) WSP(VV)IO
Any output correspondence of an input long vowel must be stressed.

WSP(VV)IO is a two-level well-formedness constraint that refers to input vowel length to assign stress to output long vowels. It requires that a stressed long vowel originally be a long vowel in the input. That is, an output long vowel is not assigned stress if it is short in the input.

Let us replace output-based WSP(VV) of (12b) and (16) with two-level-based WSP(VV)IO.

(18)

/eɪlɪən /	W I-O	*SVV	FB	NFh	NFf	W(VC)	Pσ	AR
☞ (eɪli)ən						*	*	*
eɪ(liən)	*!				*!		*	
(eɪ)liən						*	*!*	**
eɪ(li)ən	*!					*	***	*
eɪli(ən)	*!			*	*		**	
(eɪ)(liən)					*!	*		**
(eɪli)(ən)				*!	*			*
(eɪ)(li)(ən)				*!	*			***

(19)

/mɛrɪ/	W I-O	*SV#	FB	NFh	NFf	W(VC)	Pσ	AR
(mɛrɪ)		*!			*			
(mɛ)rɪ		*!	*				*	*
mɛ(rɪ)		*!	*	*	*		*	
☞ (mɛri)					*			
(mɛ)ri			*!				*	*
mɛ(ri)				*!	*		*	
(mɛ)(ri)			*!	*	*			*

In both constraint tableaux, the actual outputs (*eɪli*)*ən* and (*mɛri*) can be selected as the optimal outputs. Opacity of stress assignment is accounted for since stress assignment triggered by input vowel length takes effect in the output. However, there might be obvious problems with this view. First, two-level well-formedness constraints are equivalent to traditional rules since they both refer to the structural description and structural change. Secondly, a question on whether all well-formedness have to be restated as forms of IO constraints cannot be answered. Thirdly, referring to input forms implies giving up the core principle of Optimality Theory.

4.2 Multi-stratal evaluation

Another approach to opacity is based on serial multi-stratal constraint evaluation. A grammar is to be organized into multiple strata or levels. This implies that each stratum has its own constraint ranking that differs from the one of other strata. This view reminds of Lexical Phonology (Kiparsky 1973) which is one of the derivational theories. Actually, a multi-stratal model might be an Optimality version of Lexical Phonology. Ito & Mester (1999) adopt this view.

Multi-stratal evaluation could be a possible solution to opacity in English stress when we assume two different constraint rankings of some well-formedness constraints. What we can expect is that WSP(VV) plays a crucial role in evaluating the original input. A long vowel in a syllable should attract stress to satisfy WSP(VV). An input short vowel cannot be stressed since it would violate top-ranked WSP(VV). In order to account for (*éɪli*)*ən* and (*mɛ́ri*), WSP(VV) must be top-ranked and *ShortV-V and *ShortV# must be bottom-ranked in the first stratum. This ranking blocks vowel lengthening of input short vowels. The optimal outputs of this ranking would be (*éɪlɪ*)*ən* and (*mɛ́rɪ*). The optimal outputs (*éɪlɪ*)*ən* and (*mɛ́rɪ*) become the inputs to the second stratum. WSP(VV) must be demoted in the second stratum for it not to be active whereas *ShortV-V and *ShortV# might be promoted to be top-ranked for them to play a crucial role. This ranking selects (*éɪli*)*ən* and (*mɛ́ri*) as the optimal outputs.[6]

(20)

Stratum 1:	Input	/eɪlɪən /	/mɛrɪ/
		↓	↓
		WSP(VV)…»… *ShortV-V, *ShortV#	
		↓	↓
	Output	(éɪlɪ)(ən)	(mɛ́rɪ)
		↓	↓
Stratum 2:	Input	/(éɪlɪ)ən/	/(mɛ́rɪ)/
		↓	↓
		*ShortV-V, *ShortV# …»… WSP(VV)	
		↓	↓
	Output	(éɪli)ən	(mɛ́ri)

Although the multi-stratal model accounts for opacity of English stress system without modifying the output-based constraint format, it should

[6] Although WSP(VV) is ranked lower in Stratum 2, the optimal output (éɪli)ən preserves stress on the first long vowel. In order to account for the stressed long vowel in Stratum 2, we must posit an IO faithfulness constraint that requires faithfulness of input stress.

allow intermediate levels and derivational evaluation. What that means is that the mutli-stratal evaluation gives up the parallel mapping that is fundamental in Optimality Theory. Direct mapping of inputs to outputs cannot be fully preserved in this view due to serial constraint evaluation. Since IO well-formedness constraints are notational variants of rules, multi-stratal evaluation might be a variant of serial derivation.

4.3 Sympathy Theory

In order to provide an explanation of opacity problems, McCarthy (1998) proposes a sub-theory of Optimality Theory, which is called Sympathy Theory. The process of candidate evaluation is two-fold in a single constraint tableau in this theory. All candidates are in the relation of double correspondence. One is correspondence of an input form to all output candidates, the other is correspondence of a designated failed candidate to all other candidates. The designated failed candidate is the object of sympathy and it is selected by an IO faithfulness constraint which is called the selector. Then, a sympathetic constraint which is a faithfulness constraint evaluates the degree of correspondence of the designated candidate to other candidates in the same constraint tableau. The flower symbol ❀ points to the designated candidate and the sympathetic constraint.

Let us discuss how a failed candidate is designated through obedience to a specific faithfulness constraint and how the designated candidate exercises its sympathetic influence over the output form through faithfulness between candidates. In the case of *alien* [éɪliən], the candidate *(eɪlɪ)ən* is selected as the designated candidate since it is the most faithful to the input form. It only satisfies the designated selector constraint Dep-IO(μ) whereas others violate it. The designated candidate fails to be an optimal output since it fatally violates *ShortV-V. Because of the limit of space, some lower-ranked constraints that would not affect the analysis are not included.

(21) *alien* [éɪliən]

/eɪlɪən /	❀Faith(FtStr)	*SVV	W(VV)	Dep-IO(μ)
☞ (eɪli)ən			*	*
eɪ(liən)	*!		*	*
(eɪ)liən	*!		*	*
eɪ(li)ən	*!		*	*
eɪli(ən)	*!		**	*
(eɪ)(liən)	*!			*

(eɪli)(ən)	*!		*	*
(eɪ)(li)(ən)	*!			*
❀ (eɪlɪ)ən		*!		√

The designated failed output *(eɪlɪ)ən* functions as the base of candidate-to-candidate correspondence relation. It serves as a flower candidate. The actual optimal output should be the most faithful to this failed flower candidate in terms of a specific faithfulness constraint. I propose a flower constraint ❀Faith(FootStructure) for that purpose. It requires that the foot structure of a designated candidate be preserved in the output. The flower candidate (*eɪlɪ*)*ən* shows that the first and the second syllables belong to a foot and the final syllable is unfooted. Any output candidates that deviates from the foot structure of the flower candidate ❀(*eɪlɪ*)*ən* violate ❀Faith(FootStructure). Among the candidates that satisfies *ShortV-V, the first candidate (*eɪli*)*ən* only satisfies ❀Faith(FootStructure) while the rest of the candidates fatally violate it. Thus, the first candidate which is opaque to stress assignment is selected as the optimal output.

Note that the ranking between *ShorV-V and WSP(VV) has been undetermined, but we see here the ranking between them is crucial. *ShortV-V should rank over WSP(VV) since the flower candidate (*eɪlɪ*)*ən* loses out to the first candidate (*eɪli*)*ən* due to fatal violation of *ShortV-V. Other potential candidates which are shown in the constraint tableau of (12a) are not included here, except for (*eɪlɪ*)*ən*, because they are worse than *(eɪlɪ)ən*.

In the case of *Mary* [mέri], a faithfulness constraint Dep-IO(μ) plays a role as a selector again in determining the flower candidate. As shown below, the first three candidates satisfy Dep-IO(μ) while others violate it.

(22) 'Mary' [mέri]

/mɛrɪ/	❀Faith(FtStr)	*SV#	W(VV)	FB	Dep-IO(μ)
❀ (mɛrɪ)		*!			√
(mɛ)rɪ	*!	*		*	√
mɛ(rɪ)	*!	*		*	√
☞ (mɛri)			*		*
(mɛ)ri	*!		*		*
mɛ(ri)	*!				*
(mɛ)(ri)	*!				*

Among the first three candidates, the first one (*mɛrɪ*) is selected as the flower candidate because it satisfies FootBinarity whereas the second and the third candidates (*mɛ*)*rɪ* and *mɛ*(*rɪ*) violate it. The sympathetic constraint is again ❀Faith(FootStructure) that evaluates correspondence relations of the designated flower candidate to others. The flower candidate is worse than the optimal (*mɛri*) since it violates higher-ranked *ShortV#. Other candidates lose out to (*mɛri*) which is opaque to stress since they all fatally violate top-ranked sympathetic constraint ❀Faith (FootStructure).

As shown above, Sympathy approach fares better than the IO well-formedness approach and the multi-stratal approach. It preserves the output-based constraint format in the evaluation of correspondence of a flower candidate to other candidates in that a flower candidate is one of the possible outputs generated by Gen. Further, Sympathy approach does not posit intermediate levels which are problematic in the view of direct mapping of inputs to outputs.

However, as Kager (1999) notes, there are cases in which flower candidates never exist as actual surface forms in the related morphological paradigms. This results in a problem of abstractness of flower candidates. Referring to non-existing candidate in evaluating candidates is an ad hoc solution. A flower candidate is a disguised form of a non-existing abstract intermediate level.

In sum, three different approaches to opacity are not satisfactory in terms of the principles of Optimality Theory. All have their own problems with the theoretical assumptions. A unified solution for all kinds of opacity attested in various languages is currently unavailable in the literature. Thus, it would be beyond the scope of this paper to provide a unified approach to opacity. Instead, I explore desirable approaches that would not seriously harm the basic assumptions and principles of Optimality Theory in the analysis of opacity in English stress assignment.

5. An alternative account

The last approach to opacity could be identity-based OO correspondence which is developed by McCarthy (1995) and Benua (1995). OO correspondence is implemented by correspondence of an output to output candidates. OO correspondence approach differs from Sympathy Theory in that the output that is referred to in candidate evaluation is an actually pronounced output form. The referred output form, which is called the base, should occur in a morphologically related paradigm. Based on OO correspondence, Kager (1999) reanalyzes an example of opacity that was introduced by Brame (1974). In Palestinian a stress rule interacts vowel deletion. The stress rule places stress on a heavy penultimate syllable, otherwise on the antepenultimates. An unstressed /i/ is deleted in open non-final syllables. These rules normally apply in the following words, /fihim/ ‘he understood’, /fihim-na/ ‘we understood’, and /fihim-u/ ‘they understood’.

(23)

underlying form	:	/fihim/	/fihim-na/	/fihim-u/
stress assignment	:	fíhim	fihímna	fíhimu
vowel deletion	:	------	fhímna	fíhmu
surface form	:	[fíhim]	[fhímna]	[fíhmu]

However, vowel deletion is exceptionally blocked in some words even though /i/ stands in open non-final syllables. Vowel deletion causes non-surface-true opacity in /fihim-ni/ 'he understood me' and /fihim-ha/ 'he understood her'.

(24)

underlying form	:	/fihim-ni/	/fihim-ha/
stress assignment	:	fihímni	fihímha
vowel deletion	:	--------	--------
surface form	:	[fihímni] *fhímni	[fihímha] *fhímha

It is observed that the words in which /i/ fails to delete are faithful to the free-standing form [fíhim]. As shown in (23), [fíhim] is a actually pronounced word in the paradigm. The vowel /i/ is preserved because it has a stressed correspondent in the base [fíhim]. Kager states that the inputs are /fihim-ni/ and /fihim-ha/, the base is /fíhim/, and the actual outputs [fihímni] and [fihímha]. Two kinds of correspondence relation are involved in candidate evaluation, that is, correspondence of the inputs to the outputs and correspondence of the base to the outputs. The base is a free-standing word which is found in the morphologically related paradigm. Thus, the correspondence between the base and the outputs is output-to-output.

Following Optimality Theory, Kager employs a faithfulness constraint, HeadMax-BA which states every segment in the base's prosodic head has a correspondent in the affixed form. HeadMax-BA interacts with Max-IO and No[i] which prohibits an unstressed [i] in open non-final syllables.

(25)

Input: /fihim-na/ Base: [fí.him]	HeadMax-BA	No[I]	MAX-IO
☞ fi.hím.ni		*	
fhím.ni	*!		*

Since HeadMax-BA ranks over No[i], the first candidate wins over the second candidate which fatally violates top-ranked HeadMax-BA due to vowel deletion.

We see that OO correspondence approach is the most attractive solution in that this approach might have the advantage of preserving output-oriented well-formedness constraints and direct mapping of standard Optimality Theory. As is discussed in section 4, the two-level, multi-stratal, and Sympathy approaches are problematic since they all have to give up some basic principles of standard Optimality Theory. However, OO correspondence is also an insufficient approach since it always requires actually pronounced bases that other candidates can refer to. Therefore, OO correspondence approach fails when there does not exist a free-standing form or a morphologically related form of the output form. As is illustrated in Kager (1999), there are cases in which opacity is controlled by an abstract intermediate form which never exists in speakers' pronunciations.

Turning back to the main issue of this paper, it must be discussed which approach best-fits opacity of English stress. Although OO correspondence approach cannot account for all types of opacity, it would be better to opt for it if we can, since this approach preserves core principles of Optimality Theory. In this vein, I argue for OO correspondence approach to account for opacity that arises in *alien* by extending the notion of the base. On the other hand, OO correspondence approach is not available for opacity of *Mary*. I propose a phonetically driven solution for it.

There is a considerable variation among speakers with regard to the pronunciation of *alien*. In some dialects, speakers say [éɪlɪən] while in other dialects speakers say [éɪliən]. The latter one is an opaque case of stress assignment whereas the former is a transparent case. I argue that speakers' pronunciations can be affected by pronunciations of other individuals or dialects since language use is organic in the sense that speakers interact with others. The opacity problem can be solved if [éɪlɪən] is taken as the base in evaluating candidates. The form [éɪlɪən] is a free-standing form that is actually pronounced in many dialects. This could meet the requirements of the base. I claim that an output can function as the base in other speakers' pronunciations as long as the output form is actually pronounced by many other speakers in the language.

Thus, in the dialect where people pronounce *alien* as [éɪliən], speakers are to have the input /eɪlɪən/ and the base [éɪlɪən]. The optimal [éɪliən] is selected by correspondence relation of the input and outputs and correspondence of the base and outputs. I use Faith(FootStructure)-BA that requires identity of the foot structure of the base and the output. I added Faith(FootStructure)-BA to the constraint tableau of (12b). Several low-ranked constraints are not included in the tableau.

(26) Dialect B: [éɪliən]

Input: /eɪlɪən / Base: (éɪlɪ)ən	Faith(FtStr)-BA	*SVV	W(VV)	Dep-IO(μ)
☞ (eɪli)ən			*	*
eɪ(liən)	*!		*	*
(eɪ)liən	*!		*	*
eɪ(li)ən	*!		*	*
eɪli(ən)	*!		**	*
(eɪ)(liən)	*!			*
(eɪli)(ən)	*!		*	*
(eɪ)(li)(ən)	*!			*
(eɪlɪ)ən		*!		

The first and the final candidates satisfy Faith(FootStructure)-BA since the first and second syllables are in a foot and the final syllable is unfooted. The final candidate (*eɪlɪ*)*ən* loses to the first candidate (*eɪli*)*ən* since it fatally violates higher-ranked *ShortV-V. All other candidates in the tableau show fatal violation of Faith(FootStructure)-BA. Therefore, the opaque output (*eɪli*)*ən* turns out to be optimal.

Another opacity problem as in *Mary* needs a different treatment. Most of speakers pronounce *Mary* as [mɛri] with the word-final long vowel. There might be no significant dialectal variation for word-final vowel. So, it would be undesirable to account for opacity of [mɛri] through OO correspondence. Without resorting to other problematic approaches discussed in the earlier sections, I suggest a phonetically motivated solution.

Giegerich (1992) discusses vowel quality and vowel length of English and argues that vowel quality is more important than vowel length in distinguishing pairs of similar vowels, such as [i] : [ɪ] and [u] : [ʊ]. He notes that in identical contexts /i/ is always realized considerably longer than /ɪ/. So, the vowel in *bead* is longer than the one in *bid*. The vowel in *bean* is longer than the one in *bin*. The differences of vowel length appear to be a criterion in distinguishing [i] : [ɪ] and [u] : [ʊ]. However, the vowel of *beat* is shorter than the one of *bid*. He gives measurements of average duration of /i/ and /ɪ/.[7] Vowel phonemes display a wide range of durational

[7] Although the figures are on a typical British speaker, we may not expect significantly different figures on a typical American speaker in that Giegerich notes that American English and British English generally have the same pattern of vowel length.

variation phonetically depending on the nature of following segments. Durations are measured in centiseconds.

(27) before:	/v/	/b/	pause	/n/	/f/	/p/
/i/	36.0	28.5	28.0	19.5	13.0	12.3
/ɪ/	18.6	14.7	---[8]	11.0	8.3	7.3

These figures show that the vowel /i/ before /f/ or /p/ is realized shorter than the vowel /ɪ/ before /v/ or /b/ is. Furthermore, he provides an allophonic rule that applies to any vowel of English.

(28) allophonic vowel length

$$V \rightarrow \begin{cases} [V{:}] \ / \ \_\_\_\_\_ \ [\text{-sonorant, +voice}] \\ [V\cdot] \ / \ \_\_\_\_\_ \ [\text{+sonorant}] \text{ or pause} \\ [V] \ / \ \_\_\_\_\_ \ [\text{-sonorant, -voice}] \end{cases}$$

[V·] stands for a half-long vowel. Any vowel is long before voiced obstruents, half-long before sonorants or pause, and short before voiceless obstruents. This rule implies that vowel length is allophonic and non-distinctive in English. It is not vowel length or quantity that distinguishes the pairs of vowels. He concludes that the difference of quality among the pairs of vowels is more basic than the quantity difference is. Thus, treating the tense-lax contrast of vowels could be preferred to the long-short contrast in English, although the definition of tenseness is not clear-cut.

Following this point of view, it can be argued that English stress falls on tense vowels, rather than long vowels. Underlyingly tense vowels are stressed on the surface since they are still tense. Underlying lax vowels are lengthened in the word-final position. The question is whether lengthened vowels are tense or lax. It might be difficult to answer this question due to unclear definition of tenseness and laxness. Giegerich states that tense vowels are produced with a deliberate, accurate, maximally distinct gesture that involves considerable muscular effort whereas lax vowels are produced rapidly and indistinctly. If a vowel is phonetically long on the surface, it does not have to be underlyingly tense. It could be underlyingly lax since, as is shown in (28), vowels show context-sensitive variation of duration.

Nevertheless, it might be true that vowel tenseness and vowel length are closely related in that they affect each other in phonetic realization. I suggest that underlying lax vowels are realized long and partially tense

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[8] This gap of the measurement might have resulted from a structural condition that a monosyllabic word cannot end in /ɪ/ or /ʊ/ in English. Word-final /ɪ/ and /ʊ/ would be lengthened just as /i/ and /u/ are lengthened.

when they occur word-finally. Then, English vowels are divided into three different groups in terms of phonetic realization of tenseness and laxness: fully tense, partially tense, and lax vowels. Then, we can account for why the word-final long vowels of *Mary* and *broccoli* do not attract stress. I suggest that English stress falls on fully tense vowels on the surface. Partially tense vowels and lax vowels are not stressed. I transcribe tense vowels as [i], [u], partially tense vowels as [ɪ:], [ʊ:] and lax vowels [ɪ], [ʊ]. When we employ this three-way distinction of vowel quality, we can handle *Mary*-type of opacity without harming the core principles of Optimality Theory. Stressless word-final vowels as shown in (13b) are no longer cases of non-surface-true opacity. I argue that they are typical cases of surface-true transparency if WSP is revised as WSP(FullTense), which allows stress on fully tense vowels.[9] Diphthongs and tense vowels are realized fully tense in the outputs whereas word-final lax vowels are realized partially tense. Now, let us illustrate a constraint tableau that includes a revised version of WSP.

(29) 'Mary' [mɛ́rɪ:]

/mɛrɪ/	W(FT)	*SV#	FB	NFh	NFf	W(VC)	Pσ	AR
(mɛrɪ)		*!			*			
(mɛ)rɪ		*!	*				*	*
mɛ(rɪ)		*!	*	*	*		*	
☞ (mɛrɪ:)					*			
(mɛ)rɪ:			*!				*	*
mɛ(rɪ:)				*!	*		*	
(mɛ)(rɪ:)			*!	*	*			*

All candidates vacuously satisfy top-ranked WSP(FullTense) since there are no illustrated outputs that include full tense vowels in them. Full tensing of word-final lax vowels are worse if we rank higher a constraint against word-final tensing in ranking. The first three candidates are fatal since they violates *ShortVowel#. The last three candidates are worse than the fourth one (mɛrɪ:). They violate higher-ranked FootBinarity or NonFinality(head) whereas (*mɛrɪ:*) violates lower NonFinality(foot) only. Thus, the fourth candidate (*mɛrɪ:*) is optimal. This optimal output is a transparent one that results from the standard evaluation of possible candidates without resorting to other problematic approaches. It might be plausible to extend this phonetically driven approach to *alien*-type of

[9] It would be better to change the name of Weight-to-Stress Principle (WSP) to Tense-to-Stress Principle (TSP), though.

opacity, although I have shown that extended OO correspondence approach can give a solution for it.[10] We have assumed that the prevocalic vowel is tense, as is known in the literature. However, if the vowel is not fully tense but partially tense, then we can provide an identical account suggested for *Mary*-type of opacity.

6. Summary and Conclusion

I have shown that two different cases of non-surface-true opacity occur in English word stress. Long vowels generally attract stress, but prevocalic short vowels and word-final short vowels in the underlying forms are stressless though they are long on the surface by context-sensitive vowel lengthening. It has been known in the literature that opacity is problematic in standard Optimality Theory. Opacity seems to be well explained in rule-based derivational theories that allow intermediate levels and rule ordering. However, intermediate levels are not allowed in standard Optimality Theory since all well-formedness constraints are output-oriented.

I have shown and compared several different approaches to opacity which have been proposed and developed within the tenet of Optimality Theory. Unfortunately, they all have weaknesses in that some of basic principles of Optimality Theory should be abandoned in each approach. Two-level well-formedness constraints harm the output-based constraint format since IO well-formedness constraints refer to input forms. Multi-stratal evaluation gives up direct mapping of inputs to outputs by allowing intermediate levels. Sympathy approach is too powerful in that it allows abstract failed candidates for outputs to be evaluated. OO correspondence approach is better than other approaches since it preserves all the principles of output-based direct mapping of inputs to outputs. However, it has also a limitation that the base should be a form that is actually pronounced as a free-standing form or as part of morphologically related paradigm.

In this paper, I resort to OO correspondence approach to account for opacity caused by prevocalic stressless long vowels through extending the notion of the base to include free-standing forms pronounced in other dialects. A free-standing form of some major dialect can function as the

[10] An anonymous reader pointed out the inconsistency of treating the lengthened vowels in *alien* and *Mary*. I agree on his/her, and the comment is absolutely right. I am not able to provide a phonetic justification for which one is tense and which one is partially tense. It is because it is difficult to phonetically measure the degree of tenseness, or partly because the definition of tenseness itself is vague. Thus, I have tried not to employ differentiated tenseness in accounting for *alien*-type opacity, opting for the OO correspondence approach. In the case of *Mary*-type opacity, the OO correspondence approach is not available and I have suggested a possibility that the different degree of tenseness might play a crucial role in assigning stress.

base in other dialects. Thus, optimal outputs are selected by correspondence of the input to the outputs and correspondence of the base and the outputs. On the other hand, I suggest a phonetically driven account of opacity of word-final stressless long vowels. Stress falls on fully tense vowels on the surface. Word-final lax vowels are long but partially tense on the surface, so they are not assigned stress. With these approaches, we can preserve the core principles of standard Optimality Theory in accounting for two different cases of opacity in English word stress. Of course, it does not imply that all kinds of opacity attested in languages must be handled in this way. Providing a unified solution to all types of opacity is beyond the scope of this paper. What I have argued is that the two types of non-surface-true opacity in English stress could be better handled respectively by OO correspondence approach and phonetically driven approach.

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