An optimality theoretic account of phonological opacity in English*

Seok-keun Kang
(Wonkwang University)

Kang, Seok-keun. 2000. An optimality theoretic account of phonological opacity in English. *Studies in Phonetics, Phonology and Morphology* 6.2. 307-332. Since the inception of Optimality Theory (Prince and Smolensky 1993), opacity has been one of the most contentious issues in the theory. In this paper, considering palatalization and spirantization in English which show opacity effects, I claim that neither a traditional OT analysis nor a sympathy analysis can provide a satisfactory account of them. In order to account for the opacity effects, I assume that suffixes can impose phonological restrictions on the base to which they are attached. Given some morpho-phonological constraints which regulate the relationship between suffixes and the words, we can account for the opacity effects in a satisfactory way. (Wonkwang University)

Keywords: Optimality Theory, opacity, palatalization, spirantization, constraints

1. Introduction

Optimality Theory (Prince and Smolensky 1993) is an output-oriented theory which makes use of constraints on surface representations. The constraints, which are violable in principle, impose conflicting demands on candidates, choosing candidates with minimal violations of constraints as optimal outputs. As an output-oriented theory, OT has been claimed to have difficulties in accounting for phonological opacity, which arises out of generalizations that apparently need to be stated at some non-surface level of representation. As defined in (1), a phonological rule is said to be opaque if the rule has been rendered non-surface-true or non-surface-apparent by the application of subsequent rules (Kiparsky 1973, 1979):

(1) 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.

* This work was supported by Korea Research Foundation Grant (KRF-99-041-A00214). I would like to thank Hyunsook Kang and two anonymous reviewers for their valuable comments and suggestions. Needless to say, all responsibility for flaws and errors is mine.

Opacity effects were easily accounted for in rule-based approaches by the utilization of intermediate representations. That is, rules were allowed to apply at these intermediate stages, and then the structures that triggered these rules could be eliminated at later derivational stages. However, this kind of explanation is not available in OT, because the theory assumes no intermediate stages. Since the inception of OT, opacity has accorded lots of attention by researchers, and recently there have been many constraint-based attempts to account for the opacity effects (Benua 1997; de Lacy 1998; Walker 1998; McCarthy 1998, 1999; Churchyard 1999; Itô and Mester 1999; Goldrick 2000 notably). The main argument of these previous proposals is that CON should be altered to include constraints that relate the candidate output to forms other than the input. However, none of the previous analyses have been able to provide a successful account, and the existence of opacity effects still remains problematic for an OT approach.

The purpose of this paper is to examine two opacity-related problems in English phonology, and to show that previous proposals face some serious problems in accounting for these phenomena. As a solution to the problems at hand, I will assert that once morpho-phonological restrictions on morphemes are included in CON, the opacity effects in English can be accounted for straightforwardly. In particular, I will account for the phonological opacity by utilizing some ALIGN constraints which relate morphemes with specific roots or words.

The paper proceeds as follows. In section 2, I will introduce two cases of phonological opacity in English, i.e. palatalization and spirantization, and then present how they have been treated in previous derivational approaches. Section 3 will discuss how these opacity effects can be treated in an OT perspective. Specifically, I will show that neither a traditional OT nor Sympathy approach can provide a satisfactory account of them, and argue that a more satisfactory account is to invoke morpho-phonological constraints on morphemes.

2. Opacity in English: Palatalization and Spirantization

Before discussing phonological opacity in English in terms of OT, in this section, I will provide a brief introduction to palatalization and spirantization in English, and then show how they have been traditionally treated in a rule-based theory.

Palatalization is an independent rule of English which replaces alveolar obstruents by their strident palato-alveolar counterparts before /y/. To begin with, consider the alternations exhibited by the following data:

(2) a. impress/impression, diffuse/diffusion, profess/profession
supervise/supervision, obsess/obsession, precise/precision
digress/digression

b. race/racial, grace/gracious, commerce/commercial
efficacy/efficacious, office/official, Mars/Martian
space/spacious, Paris/Parisian, malice/malicious
Caucasus/Caucasian, ferocity/ferocious

c. artifice/artificial/artificiality, essence/essential/essentiality
consequence/consequential/consequentiality
part/partial/partiality, novice/novitiate

d. Christ/Christian/Christianity, congest/congestion
suggest/suggestion

The data in (2a) indicate that palatalization of /s, z/ takes place before the glide /y/. However, the segment /y/ responsible for palatalization is not found phonetically. Here, the later rule 'y-deletion' wipes out the environment that induced the earlier rule 'palatalization' to apply. This is a typical case of opacity, because the triggering segment is not present in surface representations.[1] As will be discussed below, pairs like *presidency* and *presidential* show that the /y/ must be followed by a vowel for palatalization to apply (cf. Rubach 1984; Halle and Mohanan 1985; Borowsky 1986).[2] Note also that it is /y/, not /i/, that causes palatalization, as the examples in (3) illustrate.

(3) a. atrocious/atrocity, capacious/capacity, social/society
b. I miss you/I miss it

For instance, the /s/ in *atrocious* followed by /y/ underlyingly undergoes palatalization, while the /s/ in 'atrocity' followed by /i/ does not. The examples in (3b) show that this is also the case even across the word boundaries; i.e., /s/ is palatalized before *you*, but not before *it*.

---

[1] A reviewer pointed out that palatalization in English should not be considered a case of opacity. That is, if we assume that palatalization is a process of the coalescing of two input segments, the resulting segment eventually coming to contain not only a target segment but also the triggering /y/, then palatalization will not meet the conditions of opacity in that the /y/ appears in the output. However, a close examination of the data in (2) reveals that palatalization is an opaque rule. For example, consider *artificiality*. Unlike in *artificial*, the glide /y/ in *artificiality* is not deleted after palatalization, but it is realized as vowel [i]. Vocalization of the /y/ in *artificiality* clearly shows that palatalization of /s/ is an opaque process.

Also note that McCarthy(1999) treats palatalization accompanied by deletion of the triggering segment /i/ as a case of opacity. For discussion, see McCarthy (1999).

[2] *SPE* (p. 230) and Borowsky (1986) assert that palatalization can apply only when the triggering /y/ is followed by an unstressed vowel. As Rubach (1984) points out, however, this is not true. Words like *artificiality* in (2c) show that it doesn't matter whether or not the following vowel is stressed; i.e., palatalization does apply in *artificiality* in spite of the stressed vowel /æ/.

The examples in (2b) behave exactly like those in (2a); i.e., they exhibit the palatalization of /s, z/ before /yal/, /yous/, /yan/[3], and the palatalizaing segment /y/ does not surface. (2c) constitutes another case of opacity in that the conditions that lead to palatalization are not apparent from surface representations. In (2c), that is, in surface terms, palatalization seems to occur before /i/ rather than /y/ (e.g., *àtifìciálity*). Finally, the examples in (2d) show that palatalization affects not only alveolar continuants, but also alveolar stops; alveolar stops are changed into palato-alveolar affricates.

There has been in the literature much discussion on the above phenomena. Within a derivational framework (e.g., Rubach 1984; Halle and Mohanan 1985; Borowsky 1986), these facts can be accounted for with crucial rule-ordering relationships[4]: palatalization precedes both y-deletion and y-vocalization, as illustrated in (4).[5]

(4) a. impres-yon → imprešyon (Pal.) → imprešon (y-del.)
b. artific-yal-ity → artifišyality (Pal.) → artifišiality (y-voc.)

In (4a), /s/ is first changed into /š/ before /y/, and then the /y/ is deleted after the resulting palato-alveorlar /š/. In (4b), after /s/ is palatalized, the palatalizing segment /y/ is vocalized in order to block a stress clash.[6] This is a case of the OCP in action.

Now let us turn to the alternations exhibited below:

(5) a. protect/protection, object/objection, react/reaction, opt/option
invade/invasion, collide/collision, allude/allusion
b. Egypt/Egyptian, part/partial, delight/delicious, Scot/Scotia

On the theory of palatalization presented so far, we would expect to find /č, □/ rather than /š, ž/ in (5). These examples clearly show that in English, spirantization is in force, turning /t, d/ to /s, z/ before palatalization can apply. It is also shown in (5) that spirantization is triggered by /y/[7].

---

[3] According to *SPE*, these suffixes are underlyingly transcribed as /yæl/, /y□s/, and /yæn/, respectively. But in this paper, I will simply employ /yal/, /yous/ and /yan/ for convenience' sake.

[4] For present purposes, it does not matter what levels or stratums the rules are assigned to.

[5] In Rubach(1984)'s analysis, for example, the relevant rules are stated as follows:
(i) Palatalization: [+obs, +cor] → [+strid, -ant] /___[-cons, -syl, -back]
(ii) y-deletion: y → ø / [+cor, -ant, +obs]___
(iii) y-vocalization: y → [+syl] / C___[+syl, +stress]

[6] Borowsky (1986) claims that this vocalization of /y/ between stresses is distributionally similar to the blocking of schwa deletion (or the distribution of syllabic sonorants) in this environment. For example, *opera* may be pronounced as [ap□r□] or [apr□], but the schwa in *operatic* can never be deleted. For further discussion, see Borowsky (1986).

[7] Rubach (1984) states the spirantization rule as follows:

[+obs, +cor, +ant] → [+strid, +cont]/{[+son], [-cont]}___[-cons, -syl, -back]

However, the glide does not appear in phonetic representations because of the operation of y-deletion, which causes opacity. For example, a sample derivation would proceed like this: /opt-yon/ □ /opsyon/ (spirantization) □ /opšyon/ (palatalization) □ /opšon/ (y-deletion). Spirantization is also known to apply to words like these:

(6) vacant/vacancy, secret/secrecy, latent/latency
adjacent/adjacency, decent/decency, agent/agency
literate/literacy, pirate/piracy, president/presidency

In (6), spirantization applies before /y/, which is in turn vocalized word-finally.[8] Here, application of y-vocalization obscures the condition under which spirantization has applied.

There are two systematic classes of words which are not subject to spirantization. First, the rule is blocked in the presence of a preceding [+continuant] segment, because its output would be a sequence of continuants, as shown in (7a):

(7) a. digest/digestion, congest/congestion
b. select/selection, expedite/expedition/expeditious, except/exception

Unlike in (7b), spirantization does not apply in (7a) in spite of the fact that in serial terms, its structural description is met underlyingly; only palatalization is in force, changing /t/ to /č/. The OCP is responsible for this failure of spirantization. Note that applying spirantization in (7a) would result in a *[sš] cluster, which is ruled out by OCP. Second, the words in (8) are also not affected by spirantization; contrary to expectation, palatalization produces /č, □/ rather than /š, ž/.

(8) habit/habitual, accent/accentual, fact/factual, grade/gradual
mortal/mortuary, sanctity/sanctuary
contempt/contemptuous, ardor/arduous
architect/architecture, literature/literature, proceed/procedure

The words above cannot be simply marked as lexical exceptions, because we can find systematic relationships between /š/ and /č/ inside the same morpheme as shown in (9).

(9) percept/perception/perceptual, indent/indention/indenture

The standard approach to this problem in terms of derivational serialism is to order the rule inserting /y/ after spirantization but before palatalization

---

[8] Rubach (1984) states y-vocalization as follows:
(i) Word-final Vocalization: y → [+syl] / C___#

(Rubach 1984, Borowsky 1986). For example, *gradual* would be derived as follows: /grad-ual/ → (spirantization does not apply) → /grad-yual/ (y-insertion) → /gra□yual/ (palatalization) → /gra□ual/ (y-deletion). This constitutes another case of opacity in that the condition of palatalization is not apparent in surface representations. Of special interest to us here is that the triggering segment /y/ appears neither in underlying representation nor in surface representation, but rather it is inserted at an intermediate stage of the derivation. As will be discussed in the following section, this case will pose a serious problem for both a traditional OT approach and a sympathy approach.

Finally, consider the examples in (10), which show that the adjective-forming suffix /y/ does not cause spirantization. These words can be accounted for simply by positing /i/ rather than /y/ in underlying representations. Recall that neither palatalization nor spirantization is conditioned by /i/.

(10) witty, catty, bitty, ratty, trendy

To summarize thus far, I have shown that both palatalization and spirantization are related to y-deletion and y-vocalization in such a way that the conditions leading to their application are obscured in surface representations. It has been shown that in derivational terms, the interaction between the rules which causes opacity effects can be accounted for by utilizing rule orderings. In the next section, I will discuss how the opacity effects can be handled in terms of OT, and argue for morpho-phonological constraints on morphemes as a solution to the problem.

3. Optimality Accounts

3.1. A traditional OT approach

One can approach the study of opacity in OT from different angles. One possibility would be to tackle the opacity problem from the perspective of a traditional OT framework (Prince and Smolensky 1993; McCarthy and Prince 1995). But the problem with this approach is simply that it cannot provide a satisfactory account of the opacity effects.

To begin with, let us consider palatalization in words like *impression*. In order to account for the palatalization here, we will basically need the following constraints:

(11) a. *Cy: [Cy] can be followed only by [u].
b. MAX: Every element of input must have a correspondent in output.
c. IDENT(F): Corresponding segments must have identical values

for the feature F.

d. UNIFORMITY: No element of output has multiple correspondents in input[9]

An explanation of the constraint *Cy is in order. As pointed out by Halle and Mohanan (1985), Borowsky (1986), Davis and Hammond (1996) and others, there exist some restrictions on distribution of glide /y/ in English. When syllable initial, /y/ may precede all vowels, as exemplified in (12a). However, when preceded by a tautosyllabic consonant, the glide may appear only when the following vowel is /u/, as shown in (12b) compared with (12c).

(12) a. yes, yam, yard, yoyo, you, yeast
b. Cyu: pure, beauty, fuel, view, cube, gules
c. *CyV: *pyes, *byati, *fyard, *cyep, *kyo

These facts suggest that there exists a constraint against the sequence CyV which holds quite generally for all vowels. And this is the constraint in (11a). [10] For example, the following tableau illustrates how the constraints in (11) work to produce the correct output:

---

[9] For OT analyses of coalescence, see Pater (1995), Lamontagne and Rice (1995), and Kang (1996) among others.

[10] In fact, there are some additional restrictions on the sequence of /Cyu/. On the one hand, the sequences [+cor, -son][y] and [+cor, +son][y] are disallowed both in stressed syllables and in unstressed initial syllables, as exemplified in (ia, b) respectively.

(i) a. *[ty]: tune, attune, tuition, tutorial
*[dy]: duke, adduce, duplicity, duration
*[sy]: suicide, assume, superlative, superior
*[zy]: Zeus, resume, Zeus
b. *[ny]: news, avenue, numerical
*[ly]: lute, lucid, lugubrious
*[ry]: rude, ruby, rutaceous

On the other hand, the sequence of [+cor, +son][y] is allowed to occur in word-medial unstressed syllables (ii). In the case of [+cor, -son][y], no /y/ appears due to the effects of the so-called palatalization and y-deletion as was discussed in the preceding section.

(ii)	[ny]: continue	*[ny]: continuity
	[ly]: volume	*[ly]: voluminous
	[ry]: querulous	*[ry]: querulity

We can account for the facts above by high-ranking constraint $*_{\sigma}[$[+cor][y], which penalizes [+cor][y] onset clusters. Word-medial [+cor, +son][y] clusters do not violate that constraint, because the coronal consonant and the /y/ are not tautosyllabic (cf. Borowsky 1986; Hammond 1999).

There are also dialectal variations between American English and British English. Unlike American English, British English allows all the clusters above except *[ly] and *[ry]. For present purposes, however, it doesn't matter how the dialectal variations can be dealt with in OT perspective.

(13)[11]

impre**s**-**y**on	*Cy	MAX-IO(y)	IDENT(hi)	UNIFORM
a.impre**sy**on	*!			
b.impre**šy**on	*!		*	*
☞c.impre**š**on			*	*
d.impre**s**on		*!		

Candidates (a, b) are immediately eliminated from the competition, because they violate high-ranking *Cy. Between the remaining candidates, (c) is selected as optimal in spite of its violations of IDENT(hi) and UNIFORM, because its competitor incurs a fatal violation of higher-ranking constraint MAX-IO(y). Note that /š/ in (c) satisfies MAX-IO(y), but it violates UNIFORMITY, which outlaws coalescence (or fusion). What I assume here is that correspondence should be extended to the featural level; i.e., a Root node of the input and that of the output will stand in a correspondence relation if features that they dominate correspond (cf. Lamontagne and Rice 1995; Kang 1996). Consider, for instance, coalescence structures like (14). Given the assumption above, the Root node of Z in the output of (14) has a double correspondence; that is, it corresponds with both X and Y of the input, as indicated through the use of the indices from each of the input segments.

(14) input output

input	output
/X_1 Y_2/	[$Z_{1,2}$]
| |	/ \
F_1 F_2	F_1 F_2

But there is a cost to representations like that in (14); i.e., the output in (14) violates UNIFORMITY, which prevents features of the input from being randomly distributed in the output. In tableau (13), however, this constraint is ranked low enough, and so whether or not it is violated is not decisive on the selection of the optimal output. It is clear from (13) that IDENT(hi) and UNIFORMITY should be ranked lower than the other two constraints; otherwise, wrong outputs would be selected. The ranking between *Cy and MAX-IO(y) does not matter here, but it will be shown later that the former must outrank the latter.

Now let us turn to the cases like *part-yal* → *[parš□l]*, where in derivational terms /t/ undergoes palatalization as well as spirantization. For example, consider the following tableau:

For detailed discussion on distribution of /y/, see Borowsky (1986), Davis and Hammond (1995), and Kang (in preparation).

11 Unstressed vowels are reduced, which is not discussed in this paper.

(15)

par**t-y**al	*Cy	MAX-IO (y)	*č	IDENT (hi)	IDENT (cont)
a. par**ty**al	*!				
b. par**sy**al	*!				*
c. par**čy**al	*!		*	*	
d. par**šy**al	*!			*	*
☞ e. par**š**al				*	*
f. par**t**al		*!			
g. par**s**al		*!			*
h. par**č**al			*!	*	

In (15), candidates (a-d) are immediately eliminated from consideration due to their violations of the top-ranked constraint *Cy. In spite of its violation of IDENT(cont), candidate (e) wins because its main challenger (h) breaks *č, which is fatal. (15) clearly shows that in order to account for words like *partial*, we need to introduce a constraint like *č, which outranks another constraint against the segment [š]. Specifically, the constraint plays a crucial role in deciding between the optimal candidate (e) and its strongest contender (h). Without the constraint *č, it would be impossible to choose the correct output in (15). If we leave the constraint *č out, then the incorrect candidate (h) would emerge as optimal. However, the problem with this analysis is that constraints like *č, which penalize a segment itself, are most unlikely to be in action in natural languages. In addition, if constraint *č were in force and its ranking were higher than that of the constraint *š, applying the constraint hierarchy to the words like *perceptual* would result in wrong outputs which contain /š/ rather than /č/, which is the actual realization of /t/.

When it comes to words like *particiality* in (2c), things get worse. For example, the following tableau clearly shows why cases like *particiality* are problematic for a traditional OT approach:

(16)

par**t**-**y**al-ity	*Cy	*Stress Clash	MAX-IO (y)	*č	IDENT (hi)	IDENT (cont)
a. pàr**ty**ály	*!	*				
b. pàr**šy**ály	*!	*			*	*
c. pàr**š**ály		*!			*	*
d. pàr**t**ály		*!	*			
☞e. àr**š**□ály					*	*
f. pàr**s**□ály						*
☜ g. àr**t**□ály						
h. pàr**č**□ály				*!	*	
i. pàr**č**ály		*!		*	*	
j. pàr**čy**ály	*!	*		*	*	

In (16), constraint *Stress Clash, which is undominated, blocks two adjacent stressed syllables. The tableau above shows that the constraint hierarchy that has been established thus far cannot be the full story, because it selects the wrong outcome for an input like *partiality*. The output which would be selected here is *pàrt□ály* rather than the actual output *pàrš□ály*. The wrong output is signalled by the left-pointing hand, whereas the desired winner is indicated by the right-pointing hand. Since candidate (g) incurs a subset of the violations[12] that (e) does, there is no re-ranking of constraints that can remedy this situation. Even if another constraint were invoked to rule out (g), a second problematic contender is (f), which also has a subset of the violations that (e) does. In order to realize the correct output, it appears necessary to call on a faith relation to a sympathy candidate, as McCarthy (1998, 1999) and others suggest. In what follows, however, I will show that a sympathetic approach is also untenable for the cases at hand.

3.2. A sympathetic approach

Another possible OT account of the opacity effects under consideration would be to utilize a theoretical device "sympathy" proposed by McCarthy (1998). According to McCarthy, sympathy is a faithfulness relationship

[12] Vocalization of /y/ in (g) also incurs a violation of DEP-IO(μ), whose low-ranking, however, does not affect the result here.

between potential output candidates, as opposed to other types of faithfulness. The idea is that the selection of the optimal candidate is influenced, sympathetically, by the phonological properties of a certain designated failed candidate, called the sympathetic candidate (which is notated with the symbol ♧). The ♧-candidate is chosen by faithfulness to the input; it is the most harmonic member of the set of candidates that obey some designated IO faithfulness constraint, called the 'selector' (which is notated by the symbol ☆). That is, compared to the other candidates in that set, the ♧-candidate better satisfies the same constraint hierarchy that selects the actual output. A ranked, violable sympathy constraint (also notated by ♧) assesses candidates for their similarity to the sympathetic candidate. For detailed tenets of the theory, see McCarthy (1998).

In the light of the foregoing discussion, let us now turn to the case under consideration. The problem identified in (16) is that the actual output form *pàrš□álity* has all of the violation marks of the failed candidates *pàrs□álity* and *pàrt□álity*, and more. Some higher-ranking constraint must compel these violations, and this is why we need to call on sympathy constraints.

Now the question we are faced with is how to select the sympathy candidate. In order to answer this question, the problem presented by the tableau in (17) must be carefully considered.

(17)

par**t**-**y**al-ity	*Cy	*Stress Clash	♧ID (hi)	♧ID (cont)	MAX-IO(y)	☆DEP (μ)	ID (cont)
a. pàr**ty**álity	*!	*	*			✓	
b. pàr**šy**álity	*!	*		*		✓	*
c. pàr**š**álity		*!		*		✓	*
d. pàr**t**álity		*!	*		*	✓	
☞e. pàr**š**□álity				*!		*	*
f. pàr**t**□álity			*!			*	
☜ g. àr**č**□álity						*	
♧ h. pàr**č**álity		*!				✓	
i. pàr**s**□álity			*!	*		*	*
j. pàr**s**álity		*!	*	*	*	✓	*
k. pàr**čy**álity	*!	*				✓	

In the opacity case under discussion, the selector is ☆DEP-IO(μ), which prohibits mora insertion in the input→output mapping. Recall that both palatalization and spirantization in English are triggered by glide /y/, not by vowel /i/. Besides, what needs to be preserved from one of the failed candidates to the actual output is the [+high] and [+continuant] features. For this reason, in (17), one of the failed candidates containing /š/ should be designated as the ♧-candidate. Given the constraint ranking presented thus far, however, candidate (h) would be incorrectly designated as the sympathy candidate, because it would be the most harmonic member of the candidates that obey ☆DEP-IO(μ). And this incorrect designation would fatally result in a wrong output (g). A question then arises as to how we can select the intended candidate as the ♧-candidate in (17). One possibility would be to invoke an anti-faithfulness constraint (cf. Horwood 1999; Alderete 2000). Accounting for morpho-phonological alternations within the framework of OT, Alderete argues for anti-faithfulness, which evaluates a pair of morphologically related words and requires an alternation in the shared stem. Anti-faithfulness causes an alternation by requiring a violation of a related faithfulness constraint.[13] In the case at hand, the anti-faithfulness constraint that we need to select the intended ♧-candidate is -IDENT(cont), which requires a violation of IDENT(cont). This constraint plays a pivotal role in the selection of ♧-candidates, as illustrated in the tableau below.

(18)

par**t**-**y**al-ity	*Cy	*Stress Clash	♧ID (hi)	♧ID (cont)	MAX-IO(y)	☆DEP (μ)	-ID (cont)	ID (cont)
a. pàr**t****y**ály	*!	*	*	*		✓	*	
b. pàr**š****y**ály	*!	*				✓		*
♧c. pàr**š**ály		*!				✓		*
d. pàr**t**ály		*!	*	*	*	✓	*	
☞e. àr**š**□ály						*		*
f. pàr**t**□ály			*!	*		*	*	
g. àr**č**□ály				*!		*	*	
h. pàr**č**ály		*!		*		✓	¡*	
i. pàr**s**□ály			*!			*		*
j. pàr**s**ály		*!	*		*	✓		*
k. pàr**č****y**ály	*!	*		*		✓	*	

[13] For detailed discussion, see the references cited.

In (18)[14], candidate (c) is designated as a ♧-candidate in spite of its violation of ID(cont), because its most challenging contender (h) incurs a fatal violation of anti-faithfulness constraint -IDENT(cont), which is indicated by ¡ . The sympathy constraints ♧ IDENT(hi) and ♧ IDENT(cont) require candidates to preserve the same height and continuity of the ♧-candidate. Of the candidates that obey the top-ranked constraints *Cy and *Stress Clash, only candidate (e) satisfies these sympathy constraints, and so it emerges as optimal.

The anti-faithfulness constraint -IDENT(cont) also seems to contribute to the decision of the intended ♧-candidates in the case of (5). For example, words like *option* can be accounted for straightforwardly in terms of the constraint ranking presented so far. Consider the following tableau:

(19)

opt-yon	*Cy	♧ID (hi)	♧ID (cont)	MAX-IO(y)	☆DEP (μ)	-ID (cont)	ID (cont)
a. op**ty**on	*!	*	*		✓	*	
b. op**sy**on	*!	*			✓		*
c. op**čy**on	*!		*		✓	*	
d. op**č**on			*!		✓	¡*	
e. op**šy**on	*!				✓		*
♧☞f. op**š**on					✓		*
g. op**t**on		*!	*	*	✓	*	

[14] In (18), if the selector were ☆MAX-IO(y), then candidate (i) would be designated as the ♧-candidate, and in the end it would be incorrectly selected as optimal, as illustrated below.

(i)

part-yal-ity	*Cy	*Stress Clash	♧ID (hi)	♧ID (cont)	☆MAX-IO(y)	DEP (μ)	-ID (cont)	ID (hi)
a. pàr**ty**álity	*!	*		*	✓		*	
b. pàr**šy**álity	*!	*	*		✓			*
c. pàr**š**ália		*!	*		✓			*
d. pàr**t**ália		*!		*	*		*	
☞ e. pàr**š**□ália			*!		✓	*		¡*
f. pàr**t**□ália				*!	✓	*	*	
g.			*!	*	✓	*	*	*
h. pàr**č**ália		*!	*	*	✓		*	*
☜♧i.					✓	*		
j. pàr**s**ália		*!			*			
k. pàr**čy**ália	*!	*	*	*	✓		*	*

In (19), (f) is chosen as the ♧-candidate, because its most challenging competitor violates the anti-faithfulness -IDENT(cont) constraint. Once the ♧-candidate is decided, all the candidates are assessed in terms of their faithfulness to the ♧-candidate. In the case at hand, the ♧-candidate itself is selected as the optimal output. Words like *option* seem to provide supporting evidence that anti-faithfulness plays a crucial role in English.

Let us examine cases such as *vacant/vacancy* in (6). Under the constraint ranking presented above, wrong outputs would be incorrectly selected as optimal, as exemplified below:

(20)

vacan**t-y**	*Cy	♧ID (hi)	♧ID (cont)	MAX-IO(y)	☆DEP (μ)	-ID (cont)	ID (hi)	ID (cont)
a. vacan**ti**		*!	*		*	*		
b. vacan**ši**					*!		*	*
☞ c. vacan**si**		*!			*			*
d. vacan**ty**	*!	*	*		✓	*		
e. vacan**t**		*!	*	*	✓	*		
f. vacan**sy**	*!	*			✓			*
g. vacan**či**			*!		*	*	*	
h. vacan**č**			*!		✓	¡*	*	
☜♧i. vacan**š**					✓		*	*
j. vacan**s**		*!		*	✓			*

In (20), candidate (i) would be incorrectly chosen as the ♧-candidate because it is the most harmonic member of the set of candidates that obey ☆DEP(μ). It would also be selected as optimal, because it fares better on ☆DEP(μ) than its strongest competitor (b). Therefore how are the correct outputs in cases like *vacant*/*vacancy* obtained? A possible option would be to invoke the M-PARSE constraint (cf. Prince and Smolensky 1993), which assigns a violation when a morpheme is not pronounced.[15] Note that the nominalizing suffix /y/ is different from the /y/ in suffixes like /yal/ in some crucial respects. First, unlike the latter which is deleted after palato-alveolars, the former is never deleted. Second, the nominalizing suffix /y/ triggers only spirantization, while the /y/ in suffixes such as /yal/ causes

[15] A morpheme is not pronounced when an appropriate constraint outranks M-PARSE. For example, haplology (e.g., 'papa' □ 'pa', 'probably' □ 'probly') can be accounted for by ranking a constraint excluding adjacent identical material higher than M-PARSE (cf. Hammond 1997).

both palatalization and spirantization of preceding alveolar consonants. Considering these reasons, we may assume that deletion of the nominalizing suffix /y/ should be treated differently from the /y/ in /yal/; i.e., deletion of the nominalizing suffix /y/ causes a violation of M-PARSE which requires morphemes/words to be parsed, whereas unparsing /y/ in /yal/ violates MAX-IO(y). Given this assumption, we can get the correct output for *vacant-y* by ranking M-PARSE higher than ☆DEP(μ), as illustrated in (21).

(21)

vacan**t-y**	*Cy	♧ID (hi)	♧ID (cont)	M-P	☆DEP (μ)	-ID (cont)	ID (hi)	ID (cont)
a. vacan**ti**			*!		*	*		
b. vacan**ši**		*!			*		*	*
☞ c. vacan**si**					*			*
d. vacan**ty**	*!		*		✓	*		
e. vacan**t**			*!	*	✓	*		
f. vacan**sy**	*!				✓			*
g. vacan**či**		*!	*		*	*	*	
h. vacan**č**		*!	*	*	✓	*	*	
i. vacan**š**		*!		*	✓		¡*	*
♧ j. vacan**s**				*!	✓			*

In the tableau above, candidate (j) loses to candidate (c), because its violation of M-PARSE is more fatal than the violation of ☆DEP(μ) incurred by (c). Hence, (c) is the optimal output.

So far, considering how a sympathy analysis could account for the opacity effects in words like *partiality*, *option* and *vacancy*, I have shown that in these cases, we may produce the correct outputs by invoking the notion of 'anti-faithfulness'; i.e., ranked properly, anti-faithfulness would help select the intended sympathy candidates and eventually the correct outputs. However, the sympathy analysis presented above is untenable in several respects. Above all, the approach, which crucially makes use of anti-faithfulness, leads to a theoretical cul-de-sac when we consider the data in (8) and (9), where the constraint ranking argued for above would result in wrong outputs. This is clearly shown in the following analysis of *gradual*, for example:

(22)

gra**d**-**y**ual	*Cy	♧ID (hi)	♧ID (cont)	MAX-IO(y)	☆DEP (μ)	-ID (cont)	ID (hi)	ID (cont)
a. gra**d**ual		*!	*	*	✓	*		
b. gra**dy**ual	*!	*	*		✓	*		
☞ c. gra□ual			*!		✓	¡*	*	
d. gra□**y**ual	*!		*		✓	*	*	
☜♧e. gra**ž**ual					✓		*	*
f. gra**žy**ual	*!				✓		*	*
g. gra□**i**ual			*!		*	*	*	

In the tableau above, candidate (e) would be incorrectly selected as optimal. The problem here is that the actual output *gra□ual* contains /□/, which would be otherwise ruled out by the constraint ranking proposed above. We may be able to choose the correct form as the optimal output by adding some other particular constraints to the CON. However, it is very undesirable to have a batch of constraints that empower linguists to do whatever they like to obtain the desired answer (cf. Katamba 1993). A theory becomes vacuous if it has constraints that can rule out all kinds of elements whenever we choose to, with no principles restricting our freedom. Effectively, this means that we are given *carte blanche* to start off with any arbitrary input, apply the constraints, and come up with the 'correct' answer. As Itô and Mester (1999) point out, besides the empirical difficulties that Sympathy encounters, it is unlikely that two radically different theoretical paradigms such as rule-based sequentialism and constraint-based parallelism would have mechanisms corresponding to each other in a direct way, with ordered rules applying in a multi-stage derivation directly matched by sympathetic faithfulness to a specially selected candidate that fulfills the role of the abstract derivational stage.

3.3. An alternative analysis

In this section, I will propose an alternative approach to the opacity cases under consideration, which makes use of morpho-phonological constraints on morphemes. It is well known that affixes can impose restrictions on the base; i.e., semantic restrictions (e.g., *short-sleeved* vs. **two-carred*), grammatical restrictions (e.g., *kindness* vs. **goness*), morphological restrictions (e.g. *reality* vs. **kindity*) and phonological restrictions (e.g., *kindly* vs. **brotherlily*) (Marchand 1969; Aronoff 1976; Siegel 1974; Stemberger 1981; Katamba 1993). For our purpose here, we can ignore the first three types of restrictions. Of special interest to us are phonological restrictions. Before advancing the specific analysis argued for in this paper, it is essential to consider what kinds of phonological restrictions suffixes impose on the base to which they are attached. To begin with, it is well attested that the suffixes which create lexically derived words may be sensitive to information contained in the words they attach to. For example, the noun-forming suffix /al/ attaches only to words which end in vowels (23) or anterior consonants (24). Besides, /al/ also requires that if more than one consonant precedes the suffix, the first consonant of the cluster must be [+sonorant], as exemplified in (25). The data in (26) further show that the suffix requires the final syllable of its base to have stress (Ross 1972; Siegel 1974).

(23) deny/denial, try/trial, withdraw/withdrawal, renew/renewal, betray/betrayal

(24) a. labials: retrieve/retrieval, deprive/deprival, arrive/arrival, survive/survival

b. coronals: appraise/appraisal, surprise/surprisal, propose/proposal, reverse/reversal, rehearse/rehearsal, disperse/dispersal, rent/rental, recount/recountal, rebut/rebuttal, remit/remittal, commit/committal, acquit/acquital, refute/refutal

c. palato-alveorlars: *judgeal, *begrudgeal, impeachal,*encroachal, *detachal

d. velars: rebuke/*rebukal, renege/*reneggal

(25) rental, reversal vs. *acceptal, *resistal[16]

(26) fídget/*fidgetal, prómise/*promissal, abándon/*abandonal, devélop/*developal

There is further evidence that suffixation crucially refers to stress information present in the word which is attached to. Taking /ful/ as an example, the suffixation constraint on it is that it attaches to nouns with final stress (Siegel 1974). Thus we have words like *peaceful*, *resentful*, and *disrespectful*, but none like **firmnessful*, **resentmentful*, **inventionful*, **daringful* and **wisdomful*, because these words do not have final stress. As Brown (1958) notes, however, there are many nouns which meet the stress requirement on the base, but which are still impossible candidates for /ful/ derivation. For example, nouns ending in /f/ and /v/ are excluded as bases for /ful/ derivation: **loveful*, **griefful*. These examples show quite clearly that there are constraints on suffixation which crucially refer to phonological information, such as stress and segmental information, present in the base.

There is another suffix which behaves like /al/ and /ful/ in imposing some phonological restrictions on the base. This is the verb-forming suffix

[16] Siegel (1974) argues that words like **dispensal*, **convinceal*, and **cursal* are accidental gaps and not systematic gaps.

/en/. The constraints on this suffix's attachment are as follows: (i) /en/ attaches to monosyllabic adjectives (e.g., *whiten*, *blacken* vs. **morosen*, **afraiden*); (ii) /en/ cannot attach to adjectives ending in nasals or liquids (e.g., **greenen*, **slimmen*, **strongen*, **nearen*, **tallen*); (iii) /en/ does not attach to adjectives ending in vowels (e.g., **bluen*, **slowen*, **grayen*) (Siegel 1974). Although /en/ normally attaches not to nouns but to adjectives, there are some cases in which /en/ appears on nouns. This is to obey the phonological constraints on its attachment. That is, /en/ attaches to the noun, rather than to the adjective, only if the adjective form violates one of the above constraints and if there is a morphologically related noun in the lexicon which is monosyllabic and ends in a non-sonorant. For example, consider the following data:

(27) lengthen/*longen, heighten/*highen, frighten/*afraiden

Long and *high* end in a nasal and a vowel, respectively. *Afraid* has two syllables. Therefore, these adjectives cannot be candidates for /en/ suffixation. On the contrary, *length*, *height* and *fright* are monosyllables and end in non-sonorants, satisfying the conditions mentioned above. Siegel (1974) claims that the condition on /en/ attachment to adjective is relaxed so that /en/ can attach to nouns which do not violate the segmental conditions on /en/ attachment. This is another evidence that suffixes impose phonological restrictions on the words they attach to.

Further evidence that suffixes are sensitive to the phonological specification of the base can be found in the attachment of the adverbial suffix /ly/ (Stemberger 1981). The suffix /ly/ derives adverbs from adjectives (e.g., *happy* vs. *happily*). However, when the adjective ends in /ly/, the attachment of the suffix /ly/ to the word is not allowed (e.g., *daily* vs. **dailily*; *friendly* vs. **friendlily*).

Given the facts mentioned above, it is very sound to assume that suffixes require the base to meet certain phonological conditions, including stress and segmental requirements. In the light of this argument, let us now turn to the opacity cases under consideration in this paper. As discussed in the preceding sections, palatalization and spirantization apply before suffixes like /yal/, /yon/, /yous/ and /y/. As a solution to the problem, I claim that these suffixes can indeed impose segmental restrictions on the words they attach to. Specifically, in order to account for the opacity effects under discussion, I will propose morpho-phonological constraints which regulate the relationship between suffixes and the bases to which they are attached. To begin with, recall that both spirantization and palataliation take place before suffixes /yal/, /yon/, /yous/ and /yary/ (e.g., *partial*, *beneficiary*, *vicious*, *division* and *option*). That is, before these suffixes, alveolar stops /t, d/ as well as alveolar fricatives /s, z/ are changed to their palato-alveolar fricative counterparts /š, ž/: that is, neither [-continuant] nor [-high] segments can appear before the suffixes. In order to account for this fact, I will propose the following constraint:

(28) Align(Q): Align suffix /Q/ with the right edge of a root that does not end in either [-continuant] or [-high] consonants. (/Q/ = {/yal/, /yon/, /yous/, /yary/, /yan/...})

ALIGN(Q) prohibits, for example, suffix /yal/ from being concatenated with a root ending either a [-continuant] or [-high] consonant.

Given this constraint, we can account for the alternations found in (2) straightforwardly. To begin with, the following tableau shows how Align(Q) conspires with other relevant constraints to produce the correct output for the input *part-yal*.

(29)

par**t-y**al	*Cy	MAX-IO(y)	ALIGN (Q)	IDENT (hi)	IDENT (cont)
a. pár**ty**al	*!		*		
b. pár**šy**al	*!			*	*
c. pár**t**al		*!	*		
☞ d. pár**š**al				*	*
e. pár**s**al		*!	*		*
f. pár**sy**al	*!		*		*
g. pár**čy**al	*!		*	*	
h. pár**č**al			*!	*	
i. pár**t**□al			*!		
j. pár**č**□al			*!	*	

In (29), of the candidates which do not violate the high-ranked constraints *Cy and MAX-IO(y), candidate (d) is the only survivor of ALIGN(Q), and so it is selected as optimal. Candidates (h, j) contain [č] which is [-cont], and candidate (i) contains [t] which is [-hi, -cont]. As shown above, once we include ALIGN(Q) in CON, we can dispense with disputable constraints like sympathy and anti-faithfulness constraints.

Now let us consider words like *partiality* in which /y/ vocalizes in order to avoid a stress clash. In this case, as illustrated in (30), *pàrš□álity* is the winner, because it best satisfies the constraint hierarchy. Violations of *Cy and *Stress Clash are fatal, because there are alternatives which satisfy them. Of the survivors, candidate (e) is the only one that does not violate ALIGN(Q), and hence it is selected as the optimal output.

(30)

par**t-y**al-ity	*Cy	*Stress Clash	MAX-IO(y)	ALIGN (Q)	IDENT (hi)	IDENT (cont)	DEP (μ)
a. pàr**ty**ália	*!	*		*			
b. pàr**šy**ália	*!	*			*	*	
c. pàr**š**ália		*!			*	*	
d. pàr**t**ália		*!	*	*			
☞e. àr**š**□ália					*	*	*
f. pàr**t**□ália				*!			*
g. àr**č**□ália				*!	*		*
h. pàr**č**ália		*!		*	*		
i. pàr**s**□ália				*!		*	*
j. pàr**s**ália		*!	*	*		*	
k. pàr**čy**ália	*!	*		*	*		

In the case of *option*, constraint ALIGN(Q) plays a crucial role in deciding the optimal output, as illustrated in the following tableau:

(31)

op**t-y**on	*Cy	MAX-IO(y)	ALIGN (Q)	IDENT (hi)	IDENT (cont)
a. op**ty**on	*!		*		
b. op**sy**on	*!		*		*
c. op**čy**on	*!		*	*	
d. op**č**on			*!	*	
e. op**šy**on	*!			*	*
☞ f. op**š**on				*	*
g. op**t**on		*!	*		

In (31), candidates (a, b, c, e) violate *Cy, which is fatal. Candidate (g) incurs a violation of MAX-IO(y), failing to be an optimal output. The remaining candidates (d) and (f) tie in satisfying the two high-ranked constraints. So the decision between them must be passed on to the next constraint ALIGN(Q). Candidate (d) violates it due to the [č] which is [-cont][17], whereas its competitor (f) satisfies it. Hence, (f) is the actual output.

Now consider the alternations in (7a), repeated as (32) here for convenience, where the preceding consonant /s/ keeps the coronal consonant /t/ from undergoing spirantization.

(32) digest/digestion, congest/congestion

Spirantization of /t/ in (32) would result in a sequence of [+continuant] coronals, which violates the Obligatory Contour Principle (OCP: Leben 1973, 1978; McCarthy 1986) in (33).

(33) OCP: In a given autosegmental tier, adjacent identical elements are prohibited.

The OCP is a constraint which forbids sequences of identical elements. The following tableau, for example, shows how the OCP constraint conspires with other constraints in order to produce correct outputs.

(34)

diges**t**-**y**on	*Cy	OCP	MAX-IO(y)	ALIGN (Q)	IDENT (hi)	IDENT (cont)	DEP (μ)
a. diges**sy**on	*!	*		*		*	
b. diges**šy**on	*!	*			*	*	
c. diges**čy**on	*!			*	*		
☞ d. diges**č**on				*	*		
e. diges**š**on		*!			*	*	
f. diges**ty**on	*!			*			
g. diges**t**on			*!	*			

As shown in (34), when it comes to words like *digestion*, constraint ALIGN(Q) does not play any pivotal role in deciding the actual outputs. The decision is completed by the higher-ranked constraints, as illustrated in the tableau. *digesčon* wins the competition in spite of its violation of ALIGN(Q), because its strongest contender *digesšon* critically contains a sequence of coronal sibilants [sš] which is a violation of the OCP.

[17] A reviewer pointed out that affricates might be considered [+continuant] sounds. But in this paper, I assume after *SPE* (pp. 31-318) that affricates are [-continuant].

Let us now turn to words like *vacancy*, in which only spirantization, but not palatalization, applies. Words like this can be given a straightforward account by utilizing constraint ALIGN(y) given below:

(35) ALIGN(y): Align the nominal suffix /y/ with the right edge of a root ending in a [+cont] consonant.

The crucial difference between ALIGN(y) and ALIGN(Q) is that unlike the latter, the former does not require the final consonant of the base to be [+high]. It does not matter whether the preceding consonant is palatalized or not. If the consonant is plato-alveorlar /š/ or /č/, then it will be ruled out by IDENT(hi). What is important here is that the preceding consonant should not be a stop. Given the appropriate ranking of constraint ALIGN(y), *vacancy* will be correctly selected as optimal, as the following tableau shows:

(36)

vacan**t-y**	*Cy	MAX-IO(y)	ALIGN (y)	IDENT (hi)	IDENT (cont)
a. vacan**ti**			*!		
b. vacan**ši**				*!	*
☞ c. vacan**si**					*
d. vacan**ty**	*!		*		
e. vacan**t**		*!			
f. vacan**sy**	*!				*
g. vacan**či**			*!	*	
h. vacan**č**				*!	
i. vacan**š**				*!	*
j. vacan**s**		*!			*

In the case of the alternations like *grade*/*gradual* given in (8) above, we need to invoke the following morpho-phonological constraint:

(37) ALIGN(U): Align suffix (U) with the right edge of a root ending in [+hi] consonants. (/U/ = {/ual/, /uary/, /uous/, /ure/...}

The following tableau, for example, illustrates how the constraint in (37) works in order to produce the correct output for the word *gradual*:

(38)

gra**d**-ual	ALIGN(U)	IDENT(hi)	IDENT(cont)
a. gra**d**ual	*!		
☞ b.gra☐ual		*	
c. gra**ž**ual		*	*!

As shown in (38), the actual output is correctly selected as optimal if ALIGN(U) outranks the other faithfulness constraints. Note that in the case at hand, it does not matter whether the glide /y/ is posited in the input or not; in either case, the constraint ranking presented thus far will produce the correct output (cf. Richness of the base: Prince and Smolensky 1993).[18]

Now finally consider the data in (10), repeated here as (39).

(39) witty, catty, bitty, ratty, trendy

As discussed in section 2, the words above can be accounted for simply by positing vowel /i/, not glide /y/, in the input. The tableau in (40) illustrates how [witi] is selected as optimal. Candidate (a), being the most faithful to the input, survives all the constraints, whereas the other candidates violate at least one of them. Therefore, candidate (a) wins.

[18] The following tableau shows that we can get the same result even under the assumption that /y/ exists in the input:

(i)

gra**d**-**y**ual	*Cy	MAX-IO(y)	ALIGN(U)	IDENT(hi)	IDENT(cont)
a. gra**dy**ual	*!		*		
b. gra**d**ual		*!	*		
c. gra☐**y**ual	*!			*	
☞ d. gra☐ual				*	
e. gra**žy**ual	*!			*	*
f. gra**ž**ual				*	*!

(40)

wi**t-i**	M-PARSE	IDENT(hi)	IDENT(cont)
☞ a. wi**ti**			
b. wi**si**			*!
c. wi**či**		*!	
d. wi**ši**		*!	*
e. wi**t**	*!		
f. wi**š**	*!	*	*
g. wi**č**	*!	*	

To summarize, I have claimed that suffixes exert some phonological restrictions on the words which they attach to. Given this assumption, we can provide a straightforward account of the opacity effects that appear in palatalization and spirantization in English. Another advantage of the analysis argued for in this paper is that it can dispense with constraints like anti-faithfulness and sympathy constraints, whose proprieties have been in dispute since their inception. We can also account for spirantization and velar-softening, which changes /k/ to /s/ in words like *music*/*musician*, in the same way. That is, the constraint hierarchy presented above correctly produces the optimal output, as shown below:

(41)

musi**k-y**an	*Cy	MAX-IO(y)	ALIGN (Q)	IDENT (hi)	IDENT (cont)
a. musi**ky**an	*!		*		
b. musi**sy**an	*!		*		*
c. musi**čy**an	*!		*	*	
d. musi**č**an			*!	*	
e. musi**šy**an	*!			*	*
☞ f. musi**š**an				*	*
g. musi**k**an		*!	*		

4. Conclusion

Considering two phonological opacity phenomena in English, i.e., palatalization and spirantization, I have shown that neither a traditional OT approach nor a sympathy approach can account for them in a satisfactory way. As an alternative account of opacity effects, I have argued for morpho-phonological constraints. Specifically, I have asserted that suffixes can impose some phonological restrictions on the words they attach to, and that once these constraints are included in the CON, the opacity phenomena can be accounted for straightforwardly. The analysis argued for in this paper is preferred over both a traditional OT approach and a sympathy approach in that it can not only dispense with disputable constraints like anti-faithfulness and sympathy constraints, but it also requires fewer constraints than the other approaches.

REFERENCES

ALDERETE, J. 2000. Dominance effects as transderivational anti-faithfulness. Ms. University of British Columbia. [ROA-407-08100].

BENUA, L. 1997. *Transderivational Identity: Phonological Relations between Words*. PhD thesis, Amherst: University of Massachusetts.

BOROWSKY, T. 1986. *Topics in the Lexical Phonology in English*. PhD thesis, Amherst: University of Massachusetts.

BROWN, A. F. 1958. *The Derivation of English Adjectives Ending -ful*. PhD thesis, Philadelphia: University of Pennsylvania.

CHOMSKY, N. and M. HALLE. 1968. *The Sound Pattern of English*. Harper and Row, New York.

CHURCHYARD, H. 1999. Topics in Tiberian Biblical Hebrew metrical phonology and prosodics. Ms. Austin: University of Texas. [ROA-404-08100].

DAVIS, S. and M. HAMMOND. 1995. Onglides in American English. *Phonology* 12:2, 159-82.

DE LACY, P. 1998. Sympathetic stress. Ms. Amherst: University of Massachusetts. [ROA-294-0199].

GOLDRICK, M. 2000. Turbid output representations and the unity of opacity. To appear in *Proceedings of NELS 30*. Amherst: GLSA.

HAMMOND, M. 1993. *Morphology*. London: Macmillan Press Ltd.

--------. 1997. Underlying representations in Optimality Theory. In I. Rocca (ed.). *Derivations and Constraints in Phonology*, pp. 349-66. Clarendon Press.

HORWOOD, G. 1999. Anti-faithfulness and subtractive morphology. Ms. Rutgers University.

ITÔ, J. and A. MESTER. 1999. On the sources of opacity in OT: coda processes in German. Ms. Santa Cruz: University of California. [ROA-374-0999].

KANG, SEOK-KEUN. 1996. An optimality theoretic account of nasal assimilation in English. *Language, Information and Computation (PACLIC 11)*, 479-88.

--------. (in preparation). An optimality theoretic account of distribution of the glide /y/ in English.
KIPARSKY, P. 1971. Historical linguistics. In W. Dingwall (ed.). *A Survey of Linguistic Science*. College Park, MD: University of Maryland Press.
--------. 1973. Phonological representations. In O. Fujimura (ed.). *Three Dimensions of Linguistic Theory*, pp. 93-106. Tokyo: Taikusha.
LAMONTAGNE, G. and K. RICE. 1995. A correspondence account of coalescence. Ms. Toronto: University of Toronto.
LEBEN, W. 1973. *Suprasegmental Phonology*. New York: Garland.
--------. 1978. The representation of tone. In V. Fromkin (ed.). *Tone A Linguistic Survey*, pp. 177-220 New York: Academic Press.
MCCARTHY, J. 1986. OCP effects: gemination and antigemination. *Linguistic Inquiry* 17, 207-64.
--------. 1998. Sympathy & phonological opacity. Ms. Amherst: University of Massachusetts. [ROA 239-0198].
--------. 1999. Sympathy, cumulativity, and the Duke-of-York gambit. Ms. Amherst: University of Massachusetts. [ROA-315-0499].
MCCARTHY, J. and A. PRINCE. 1995. Faithfulness and reduplicative identity. In Beckman, J., L. Walsh Dickey and S. Urbanczyk (eds.). *University of Massachusetts Occasional Papers 18: Papers in Optimality Theory*, pp. 249-384. Amherst: GLSA, University of Massachusetts.
MYERS, S. 1995. OCP effects in optimality theory. Ms. Austin: University of Texas.
PATER, J. 1995. Austronesian nasal substitution and other NC effects. Ms. McGill University.
PRINCE, A. and P. SMOLENSKY. 1993. Optimality Theory. Ms. Rutgers University and University of Colorado.
ROSS, J. R. 1972. A reanalysis of English word stress. In M. K. Brame (ed.). *Contributions to Generative Phonology*. Austin: University of Texas Press.
RUBACH, J. 1984. Segmental rules of English and cyclic phonology. *Language* 60, 21-54.
SIEGEL, D. 1974. *Topics in English Morphology*. PhD thesis. MIT.
STEMBERGER, J. P. 1981. Morphological haplology. *Language* 57:3, 791-817.
WALKER, R. 1998. *Nasalization, Neutral Segments, and Opacity Effects*. PhD thesis, UCSD. [ROA-405-08100].

English Department
Wonkwang University
Iksan, Chonbuk
Korea 570-749
E-mail: skkang@wonkwang.ac.kr