A Stratal OT Approach to a Noun-Verb Asymmetry With Respect to Opacity in Korean

Jiwon Yun
Cornell University

A Stratal OT Approach to a Noun-Verb Asymmetry With Respect to Opacity in Korean

Abstract
This paper revisits the well-known opacity caused by the interaction of post-obstruent tensification and coda cluster simplification in Korean and suggests a new class of data that threatens the validity of previous approaches. The new data shows that the opacity occurs only if the input belongs to a certain morphological category such as verb. Therefore, it calls for a theory in which morphology and phonology are systematically interleaved, such as Stratal OT (Kiparsky, 2000). I show that the Stratal OT approach provides a solution to the problem since it adds derivational effects as well as morphological insights to an OT grammar.

A Stratal OT Approach to a Noun-Verb Asymmetry With Respect to Opacity in Korean

Jiwon Yun*

1 The Initial Puzzle: Opacity

The purpose of this paper is to investigate a certain phenomenon that involves both phonological opacity and noun-verb asymmetry, and to show that it calls for a theory in which morphology and phonology are systematically interleaved.

Although Korean allows consonant clusters to occur in syllable-final position at the morpho-phonemic level, it does not allow more than one consonant in that position at the phonetic level. Thus a consonant cluster is reduced to a singleton consonant when it is in coda position as illustrated in (1). Korean also has a post-obstruent tensification process: lax obstruents change to their tense counterparts when followed by other obstruents as in (2).

(1) Coda Cluster Simplification (CCS)

a. /kaps/	→ [kap]	'price'
b. /moks/	→ [mok]	'share'
c. /salm/	→ [sam]	'life'

(2) Post-Obstruent Tensification (POT)

a. /kuk + pap/	→ [kuk.p'ap]	'rice served in soup' ('soup' + 'rice')
b. /nic + cam/	→ [nit.c'am]	'oversleeping' ('late' + 'sleeping')
c. /ip + to/	→ [ip.t'o]	'mouth' + particle 'also'

When the two processes, coda cluster simplification (CCS) and post-obstruent tensification (POT), interact, opacity may occur as in (3) because POT occurs even though its context disappears on the surface. The lateral does not make the following obstruents tense; it only makes them voiced, as in (4).

(3) Opaque application of POT after coda cluster

a. /halt^h + ta/	→ [hal.t'a]	'to lick' + declarative suffix
b. /palp + ko/	→ [pal.k'o][1]	'to tread on' + conjunctive suffix
c. /ilk + so/	→ [il.s'o]	'to read' + declarative suffix

(4) Voicing after lateral

a. /kal + ta/	→ [kal.da]	'to grind' + declarative suffix
b. /mul + ta/	→ [mul.da]	'to bite' + declarative suffix

A rule-based analysis would explain this by positing that the post-obstruent tensification rule applies before the coda cluster simplification rule.

(5) A rule-based account (cf. Shim, 1995)

Underlying Form	/malk + ta/
Syllabification	malk.ta
POT	malk.t'a

*I would especially like to thank Michael Wagner and John Whitman for their helpful comments and suggestions. I am also grateful to the participants of the Research Workshop at Cornell University: Molly Diesing, Masayuki Gibson, Zhiguo Xie, Seongyeon Ko; and the audience of the Research Workshop Student Presentation, the Cornell Linguistics Circle practice talk, and the 32nd Penn Linguistics Colloquium as well as the reviewers of PLC 32 for their thoughtful comments.

[1]The CCS patterns may differ from dialect to dialect (e.g., /lp/ can be simplified to either /l/ or /p/), but I will concentrate on the instances where opacity can occur.

CCS	mal.t'a
Surface Form	[mal.t'a]

However, it causes a problem for classical OT approaches, which do not allow for derivations with intermediate steps. Since the environment for tensification has disappeared, there is no apparent motivation to make the obstruent tense in the surface form. Therefore, classical OT approaches predict the wrong output, as exemplified in the following tableau:

	*CC	VOICING	MAX-IO-C	*OO	IDENT-IO (tense)	IDENT-IO (voice)
a. malk.ta	*!			*		
b. mal.ta		*!	*			
c. ☹ mal.da			*			*
d. ☞ mal.t'a			*		*!	

(☹: the wrong winner; ☞: the actual surface form)
Table 1: An OT account (cf. Iverson & Lee, 1995; Moon, 2001)[2].

2 Previous Approaches to the Opacity Problem

Since opacity is a big challenge for OT, there have been various attempts to find solutions for it within the OT framework. However, not all the attempts provide solutions for every kind of opacity problem. Specifically, the case mentioned in the previous section is a relatively tough one. Kim (2003), who claims that any OT-based analysis is inadequate to explain opacity, shows that the OT approaches to opacity including OO-correspondence (Benua, 1995; McCarthy, 1995) and Local Conjunction (Lubowicz, 1998; Ito and Mester, 2003) fail to give a proper solution to the interaction between POT and CCS in Korean. In this section, I will briefly review two successful proposals, namely, the Sympathy Approach (Tak, 2001) and the Geminate Approach (Lee, 2002).

2.1 The Sympathy Approach

Tak (2001) explains the opacity problem by using the notion of Sympathy (McCarthy, 1998). Sympathy Theory posits a "sympathetic candidate" which is similar to an intermediate stage in generative phonology, and "sympathetic constraints" which require other candidates to be faithful to the sympathetic candidate on the surface. The candidate which would be optimal if not for the effects of sympathy is ruled out by the sympathy constraints so that the opaque process that chooses the actual output becomes transparent.

According to Tak's account, the sympathetic faithfulness constraint ❀IDENT-IO (tense) requires the output and the sympathetic candidate [malk.t'a] to be identical with respect to tense. Then the actual output [mal.t'a] is now the optimal candidate because the otherwise optimal candidate [mal.da] violates the sympathetic constraint ❀IDENT-IO (tense).

/malk + ta/	*CC	*OO	❀IDENT-IO (tense)	IDENT-IO (tense)	VOICING
a. malk.ta	*!	*!	*		
b. ❀malk.t'a	*!			*	
c. mal.ta			*!		*
d. ☞mal.t'a				*	
e. mal.da			*!		

Table 2: The Sympathy Approach (Tak, 2001).

[2]For consistency and readability, I use the same name for similar constraints that appear with different names in the previous studies. I ignore some minor differences in those constraints that do not affect the validity of the argument in my paper. The constraints that are used throughout this paper are listed below:

*CC: No consonant clusters in coda position

*OO: No lax obstruent sequences

VOICING: Intersonorant lax stops are voiced.

2.2 The Geminate Approach

It is not uncontroversial that lax and tense consonants in Korean are distinguished in terms of features. Though most researchers assume that tense consonants have the feature [+constricted glottis] (Kim-Renaud, 1974; Cho and Inkelas, 1994; Oh and Odden, 1997, among others), some have claimed that tense consonants are underlyingly geminate lax consonants (Martin, 1982; Han, 1992).

Exploring this issue, Lee (2002) proposes that the geminate representation of tense consonants enables a simple and principled account for the interaction between POT and CCS. According to her analysis, the apparent opaque application of POT is actually transparent: the high ranking of MAX-IO-C guarantees the choice of [mal.t'a] rather than [mal.da] as shown in the following tableau.

/malk + ta/	*CC	MAX-IO-C	*OO	DEP-IO-C
a. malk.ta	*!		*	
b. malk.t'a	*!			*
c. mal.ta		*!		
d. ☞mal.t'a				
e. mal.da		*!		

Table 3: The Geminate Approach (Lee, 2002).

3 A New Puzzle: Noun-Verb Asymmetry

Now we have at least three approaches that can explain the above opacity problem: the Rule-based account, the Sympathy approach, and the Geminate approach.[3] However, there is another problem which has been overlooked in previous discussions: though POT applies opaquely in many cases as repeated in (6), there also exist cases where POT does not apply in the same phonological environment as in (7).

(6) Opaque application of POT
a. /palp + ko/ → [pal.**k'**o] 'to tread on' + conjunctive suffix
b. /malk + ta/ → [mal.**t'**a] 'to be clear' + declarative suffix

(7) No application of POT
a. /jətəlp + kwa/ → [jə.dəl.**g**wa] 'eight' + conjunctive particle
b. /talk + put^{h}ə/ → [tal.**b**u.t^{h}ə] 'chicken (in Kyongsang Korean)' + particle ('from')

The difference between the cases such as (6) and (7) is that in the former, the morphemes that contain the consonant cluster are verbal elements (i.e., verbs and adjectives) and in the latter they are nominal elements (i.e., nouns, pronouns, and bare numerals). For simplicity, I will refer to this categorical asymmetry as noun-verb asymmetry. In fact, previous approaches to the interaction between POT and CCS have only concerned verbs and failed to notice that nouns do not show opacity.[4]

Since the stand-alone forms of the nouns in (7) are [jə.dəl] and [tal], respectively, one might argue that the obstruent in the coda clusters exists only in the orthography and no longer does in the phonological underlying forms. However, the consonant clusters are fully realized in the sur-

[3]I will not discuss the theoretical weaknesses of these approaches in this paper because the empirical problem that will be discussed in the next section is more noteworthy: they cannot fully explain the data for which they are proposed to account. See Kiparsky (2004) for a criticism on the notion of Sympathy, and Cho and Inkelas (1994) for arguments against geminate accounts of tenseness in Korean.

[4]So far, the only work I have found that mentions the noun-verb asymmetry in POT is Tak (1997), which attempts to provide an account for this asymmetrical behavior by means of Uniform Exponence (cf. Kenstowicz, 1996). However, her approach to this phenomenon has a theoretical flaw since it relies on a markedness constraint that refers to the underlying form, which is not compatible with common principles of OT.

face form when they are followed by vowel-initial particles.[5]

(8) No CCS when followed by vowel-initial particles
a. /jətəlp + i/ → [jə.də**l.b**i] 'eight' + nominative particle
b. /talk + ɨl/ → [ta**l.g**ɨl] 'chicken' + accusative particle

The new data in (7) causes a direct problem with the above approaches to opacity. The Sympathy Approach and the Geminate Approach both fail to predict the transparent output in nominal inflections, because they just predict the same opaque output as in verbal inflections. The following tableaux show that both approaches select the wrong output [jə.dəl.k'wa] for (7a).

/jətəlp + kwa/	*CC	*OO	❀IDENT-IO (tense)	IDENT-IO (tense)	VOICING
a. jə.təlp.kwa	*!	*!	*		*
b. ❀ jə.təlp.k'wa	*!			*	*
c. jə.təl.kwa			*!		*
d. ☹ jə.dəl.k'wa				*	
e. ☞ jə.dəl.gwa			*!		

Table 4: The Sympathy Approach (Tak, 2001).

/jətəlp + kwa/	*CC	MAX-IO-C	*OO	DEP-IO-C
a. jə.təlp.kwa	*!		*	
b. jə.təlp.k'wa	*!			*
e. jə.təl.kwa		*!		
f. ☹ jə.dəl.k'wa				
g. ☞ jə.dəl.gwa		*!		

Table 5: The Geminate Approach (Lee, 2002).

Notice that even a rule-based analysis fails to explain this new kind of data because it also predicts the wrong opaque output in nominal inflections. Thus, it is not the case that the rule-based framework is always superior to the OT framework when opacity is involved.

(9) A Rule-based Account

Underlying Form	/jətəlp + kwa/
Syllabification	jə.təlp.kwa
POT	jə.təlp.k'wa
CCS	jə.təl.k'wa
Surface Form	*[jə.dəl.k'wa]

4 Previous Approaches to Noun-Verb Asymmetries

The previous section shows that an adequate solution to explain all the data should refer to morphological categories such as nouns and verbs. Indeed, different behaviors of nouns and verbs with respect to phonological processes are often observed in a number of languages, and there have been several approaches to account for asymmetries between noun and verb phonology (Kenstowicz, 1996; Smith, 1997; Lee, 2001; Kang, 2004; Ko, 2006, among others). However, those previous approaches to noun-verb asymmetry cannot explain the asymmetry that concerns us because they depend on the assumption that noun-verb asymmetries come from the special phonological status of nouns, which does not play a crucial role in solving the problem here.

For instance, let us examine the application of the Base-Output Correspondence (BOC) approach (Ko, 2006), one of the most recent analyses for noun-verb asymmetries in Korean phonol-

[5]In fact, some consonant clusters in nouns are indeed disappearing in the speech of younger speakers: e.g. /jətəlp + i/ → [jə.də.ri]. It is possible that some underlying clusters in nouns indeed remain only in the orthography. However, this fact does not undermine my argument because tensification never occurs in nominal inflections as in (7), even if there the noun stems have underlying clusters as in (8).

ogy.[6] The basic assumption of this approach is that the free-standing form (i.e., Base) of nouns in Korean is taken as a reference form in evaluation of output candidates. The definition of BOC is given as follows:

(10) Base-Output Correspondence (Ko, 2006:217 (44); adopted from Kager, 1999:248, 263)
Given two strings S1 and S2, related to one another as Base-output, Base-output correspondence is a relation R from the elements of S1 to those of S2. Elements $\alpha \in$ S1 and $\beta \in$ S2 are referred to as correspondents of one another when $\alpha R \beta$.

Though it seems to solve a variety of noun-verb asymmetry puzzles in Korean phonology, the BOC approach fails to provide a solution to the opaque application of POT for the following reasons.

Firstly, verb stems cannot stand alone without suffixes in Korean, thus the BOC constraints that evaluate candidates against a free-standing output are not responsible for any opacity observed in verbal inflections. The following tableau illustrates that BOC constraints do not show any effect in verbal inflections, as the columns for those constraints are always empty.

/malk + ta/	VOICING	*OO	*CC	MAX-IO-C	DEP-BO-C	IDENT-IO (tense)	IDENT-IO (voice)
a. malk.ta		*!	*!				
b. mal.ta	*!			*			
c. ☹ mal.da				*			*
d. ☞mal.t'a				*		*!	

Table 6: The BOC Approach (cf. Ko, 2006:232 (74))[7].

Secondly, the opaque application of POT does not affect the evaluation of candidates against the Base because tensification occurs outside the part of the form that corresponds to the Base. As shown in the following tableau, the strongest candidates, in either transparent or opaque contexts ([jə.dəl.gwa] and [jə.dəl.k'wa], respectively), are equally faithful to the Base [jədəl]. Therefore, BOC constraints cannot evaluate those competing candidates.[8]

/jətəlp + kwa/ **Base: [jədəl]**	VOICING	*OO	*CC	MAX-IO-C	DEP-BO-C	IDENT-IO (tense)	IDENT-IO (voice)
a. jə.təlp.kwa		*!	*!				
b. jə.təl.kwa	*!			*			
c. ☞ jə.dəl.gwa				*			**
d. jə.dəl.k'wa				*		*!	*

Table 7: The BOC Approach (cf. Ko, 2006:233 (75)).

Since the BOC approach at least guarantees the selection of the proper output for nouns as in the above tableau, while the Sympathy or Geminate approach does so for verbs, one might expect that we would be able to obtain the correct outputs if we added the assumptions of the Sympathy or Geminate approach to the BOC approach. However, such a combination does not make the situation better because now it simply predicts opaque outputs for all cases. For example, the following tableaux show that the combination of the BOC and Geminate approaches predicts the

[6]I focus on the BOC analysis here because the other approaches seem to have even more empirical shortcomings. See Ko (2006) for arguments against those approaches. Indeed, none of them can explain the noun-verb asymmetry in the interaction between POT and CCS because they all share the same limitation that they can only explain opacity in nouns, but not in verbs.

[7]The free ranking between Max-IO-C and Dep-BO-C, which was posited in Ko (2006), is not presented here because it has no effect (i.e., it does not yield more than one output) in the examples in this paper.

[8]Therefore, the opaque application of POT still remains unsolved even if we posit that verbs can have some kind of Base (cf. Kang, 2006).

right optimal output for verbs, but not for nouns.

/malk + ta/	VOICING	*OO	*CC	MAX-IO-C	DEP-BO-C	IDENT-IO (tense)	IDENT-IO (voice)
a. malk.ta		*!	*!				
b. mal.ta	*!			*			
c. mal.da				*!			*
d. ☞mal.t'a							

Table 8: BOC + Geminate.

/jətəlp + kwa/ **Base: [jədəl]**	VOICING	*OO	*CC	MAX-IO-C	DEP-BO-C	IDENT-IO (tense)	IDENT-IO (voice)
a. jə.təlp.kwa		*!	*!				
b. jə.təl.kwa	*!			*			
c. ☞ jə.dəl.gwa				*!			**
d. ☹ jə.dəl.k'wa							*

Table 9: BOC + Geminate.

5 Proposal: Stratal OT

So far, we have seen that the interaction of POT and CCS poses complex problems. It involves opacity, which calls for an intermediate stage of a serial derivation, and it also exhibits noun-verb asymmetry, which implies that nominal and verbal inflections differ with respect to the intermediate stage. The important point is that the asymmetric opacity is not because of the direct effect of some arbitrary extrinsic rule ordering but rather due to the indirect influence of intrinsic morphological structure.

My intuition that explains both the opacity and noun-verb asymmetry is that nominal inflection takes place at some later level in phonology than verbal inflection. In this section, I propose an analysis based on Stratal OT (Kiparsky, 2000), which derives constraint opacity from inter-level seriality.

5.1 Stratal OT

Unlike other proposals that have been made to deal with phonological opacity within an OT framework, Stratal OT abandons the basic assumption of OT in which only two levels of representation (input and output) are allowed. It can be thought of as a combination of Optimality Theory and Lexical Phonology in that it assumes distinct strata corresponding to the different levels of Lexical Phonology. Each stratum in Stratal OT is an OT grammar with different constraint rankings, and all the strata are serially linked. In particular, the model proposed by Kiparsky (2000) assumes three strata which correspond to stem, word, and phrase (post-lexical) levels.

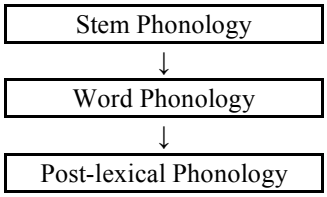

Figure 1: Stratal OT (Kiparsky, 2000).

The output of one stratum is the input to the next stratum. Constraints are transparent except that later level processes can mask earlier level ones, which may result in opacity.

5.2 Proposal

Based on the three-strata OT model (Kiparsky, 2000), I assume that suffixes are attached to verbs at the stem level, whereas particles combine with nouns at the word level. This assumption is supported by the following arguments.

Firstly, nominal inflection takes place at a later stratum than verbal inflection. This argument is supported by the morphosyntactic fact that post-nominal particles can also follow verbal inflections but verbal inflections never follow post-nominal particles as illustrated in (11). Under a generalization like the Mirror Principle (Baker, 1985), the order of dependent morphology reflects the order of derivation.

(11) a. ilk + ko + put^{h}ə 'to read' + conjunctive suffix + particle ('from')
('since reading something')

b. *ilk + put^{h}ə + ko

Secondly, nominal inflection does not take place at the post-lexical (i.e., phrasal) level. When there is a phrase boundary between a noun stem and the following morpheme, this combination behaves differently from nominal inflections. For example, /c^h/ is neutralized to /t/ in coda position, as (12a) shows, but such coda neutralization does not occur when the coda consonant is followed by a vowel-initial particle, because the coda consonant is resyllabified to onset position, as in (12b). However, neutralization is not observed if there is a phrase boundary after the noun, even if resyllabification occurs. In (12c), /k'oc^h/ + /ap^h/ ('flower' + 'front') can be pronounced as [k'ot.ap] or [k'o.dap] in fast speech, but never can be *[k'o.c^{h}ap]. If we assume that nominal inflection occurs at the post-lexical level (i.e., both *ap^h* 'front' and the particle *i* are added to the noun at the same level), we cannot explain the difference between (12b) and (12c).

(12) a. /k'oc^h/ → [k'ot] 'flower'
b. /k'oc^h/ + /i/ → [k'o.c^{h}i] 'flower' + nominative particle
c. /k'oc^h/ + /ap/ → [k'ot.ap˥] ~ [k'o.dap˥], *[k'o.c^{h}ap˥]
'flower' + 'front' ('in front of the flowers')

Consequently, the only possible conclusion that satisfies the above two conditions is that verbal inflection occurs at the stem level, while nominal inflection occurs at the word level.

The following tableaux show the crucial constraint rankings at each level and how the Stratal OT Approach predicts the correct output in both verbal and nominal inflections. At the stem level, coda cluster simplification does not occur because *CC is dominated by MAX-IO-C. So in the case of verbal inflection, tensification transparently occurs at the stem level because the obstruent in the cluster (/k/) still remains in the output. And at the word level, cluster simplification occurs and we get the output [malt'a].

/malk + ta/	*OO	MAX-IO-C	IDENT-IO (tense)	*CC	VOICING
a. malk.ta	*!			*	
b. ☞malk.t'a			*	*	
c. mal.ta		*!			*
d. mal.t'a		*!	*		
e. mal.da		*!			

Table 10: The Stratal OT Approach—Verbal Inflection (Stem Level).

/malkt'a/	*CC	*OO	VOICING	MAX-IO-C	IDENT-IO (tense)
a. malk.t'a	*!				
b. mal.ta			*!		*
c. ☞mal.t'a					
d. mal.da					*!

Table 11: The Stratal OT Approach—Verbal Inflection (Word Level).

On the other hand, in nominal inflection, particles do not appear at the stem level so the bare noun stem undergoes stem-level processes, and nothing actually occurs. Then, at the word level, the particle is added to the noun stem, yielding the transparent output [jə.dəl.gwa].

/jətəlp/	*OO	MAX-IO-C	IDENT-IO (tense)	*CC	VOICING
a. ☞jətəlp				*	
b. jətəl		*!			

Table 12: The Stratal OT Approach—Nominal Inflection (Stem Level).

/jətəlp + kwa/	*CC	*OO	VOICING	MAX-IO-C	IDENT-IO (tense)
a. jə.təlp.kwa	*!	*!			
b. jə.təl.kwa			*!	*	
c. ☞ jə.dəl.gwa				*	
d. jə.dəl.k'wa				*	*!

Table 13: The Stratal OT Approach—Nominal Inflection (Word Level).

6 Conclusion

In this paper, I suggested a new class of data that shows the opacity caused by the interaction of post-obstruent tensification and coda cluster simplification in Korean is observed in verbs but not in nouns, which threatens the validity of previous approaches predicting that the opacity occurs indiscriminately. The Stratal OT approach provides a solution to the problem since it adds derivational effects as well as morphological insights to an OT grammar.

A remaining issue is whether the Stratal OT approach suggested in this paper can also explain other various kinds of opacity and noun-verb asymmetry in Korean phonology. It would also be worth investigating more phenomena to see whether this model fits in the large picture of universal phonology.

References

Baker, Mark. 1985. The Mirror Principle and morphosyntactic explanation. *Linguistic Inquiry* 16:373–415.

Benua, Laura. 1995. Identity effects in morphological theory. In *The Handbook of Phonological Theory*, ed. J. Goldsmith, 206–244. Oxford: Blackwell.

Cho, Young-mee Yu, and Sharon Inkelas. 1994. Post-obstruent tensification in Korean and geminate inalterability. In *Theoretical Issues in Korean Linguistics*, ed. Y.-K. Kim-Renaud, 45–60. Stanford, CA: CSLI.

Han, Jeong-Im. 1992. On the Korean tensed consonants and tensification. *Chicago Linguistics Society* 28:206–223.

Ito, Junko, and Armin Mester. 2003. On the sources of opacity in OT: coda processes in German. In *The Syllable in Optimality Theory*, ed. C. Féry and R. van de Vijver, 271–303. Cambridge: Cambridge University Press.

Iverson, Gregory K., and Shinsook Lee. 1995. Variation as optimality in Korean cluster reduction. In *Proceedings of the Eleventh Eastern States Conference on Linguistics*.

Kang, Eungyeong. 2004. Edge-Demarcation in Phonology. Doctoral Dissertation, Cornell University.

Kang, Yoonjung. 2006. Noun-verb asymmetry in Korean. Presented at MOT (Montreal-Ottawa-Toronto) Phonology Workshop, February 2006, University of Toronto.

Kenstowicz, Michael. 1996. Base-identity and uniform exponence: alternatives to cyclicity. In *Current Trends in Phonology: Models and Methods*. European Studies Research Institute, University of Salford Publication, Manchester, 363–394.

Kim, Gyung-Ran. 2003. Opacity revisited: against OT-based analyses. *Studies in Modern Grammar* 34:171–189.

Kim-Renaud, Young-Key. 1974. Korean Consonantal Phonology. Doctoral Dissertation, University of Hawaii.

Kiparsky, Paul. 2000. Opacity and cyclicity. *The Linguistic Review* 17:351–367.

Kiparsky, Paul. 2004. Stratal OT vs. Sympathy. Ms., Stanford University.

Ko, Heejeong. 2006. Base-output correspondence in Korean nominal inflection. *Journal of East Asian Linguistics* 15(3):195–243.
Lee, Shinsook. 2002. A constraint-based approach to the opacity between consonant cluster simplification and tensification in Korean. *Japanese/Korean Linguistics* 11:289–302.
Lee, Yongsung. 2001. The noun-verb asymmetry in Korean phonology. *Studies in Phonetics, Phonology, and Morphology* 7:375–397.
Lubowicz, Anna. 1998. Derived environment effects in OT. In *Proceedings of the 17th West Coast Conference on Formal Linguistics*, ed. K. Shahin, S. Blake and E. S. Kim, 451–465. Stanford, CA: CSLI.
Martin, Samuel. 1982. Features, markedness, and order in Korean phonology. In *Linguistics in the Morning Calm*, 601–617. Seoul: Hanshin.
McCarthy, John. 1995. Extensions of faithfulness: Rotuman revisited. Ms., University of Massachusetts, Amherst. [ROA-110, http://roa.rutgers.edu]
McCarthy, John. 1998. Sympathy and phonological opacity. Ms., University of Massachusetts, Amherst. [ROA-252 http://roa.rutgers.edu]
Moon, Yang-soo. 2001. An Optimality-Theoretic approach to Korean consonant cluster simplification. *Journal of Humanities* 44:95–118. [In Korean]
Oh, Mira, and David Odden. 1997. The phonological representation of Korean tense consonants. *Korean Journal of Linguistics* 22:331–349.
Shim, Minsu. 1995. Syllabification and consonant cluster simplification in Korean. In *Proceedings of the 6th Annual Meeting of the Formal Linguistics Society of Mid-America*, Volume 1.
Smith, Jennifer. 2001. Lexical category and phonological contrast. In *PETL 6: Proceedings of the Workshop on the Lexicon in Phonetics and Phonology*, 61–72.
Sohn, Ho-Min. 1999. *The Korean Language*. Cambridge University Press.
Tak, Jin-Young. 1997. Uniform exponence in accounting for post-obstruent tensification with special reference to Korean. *Harvard Studies in Korean Linguistics* 7:213–224.
Tak, Jin-Young. 2001. Opacity in Korean: a Sympathy approach. *Korean Journal of Linguistics* 26(3):587–602.

Department of Linguistics
Cornell University
Ithaca, NY 14853-4701
jy249@cornell.edu