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# Pronunciation of Sonorant Clusters in English for Korean Speakers: A Constraint-based Approach*

**Chin-Wan Chung**
(Chonbuk National University)

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This paper discusses why Korean speakers have problems in pronouncing some medial sonorant clusters in English. We argue that the main reasons lie in the sonority sequence requirement difference between the two languages. English does not have any specific sonority sequence preference between the medial sonorant sequences while Korean has a strict requirement between the two sonorants over a syllable boundary. This sonority sequence requirement difference between the two languages acts as an interference for Korean speakers in learning English pronunciation. This barrier for Korean speakers in acquiring correct pronunciation is implemented in a constraint ranking difference in the Optimality Theory, which is not familiar for Korean speakers. Understanding the details of sonorant production mechanisms along with the different constraint ranking will facilitate the learning process of Korean speakers learning English.

**[English pronunciation/constraints/clusters/optimality/ranking]**

## I. INTRODUCTION

Learning a foreign language is a hard task especially when it comes to pronunciation of the sounds in a target language that do not exist in a native language. Acquisition of English for Korean speakers is a good example. Except for the systematic differences in syntax and vowel system between the two languages, English consonants such as labio-dental fricatives, inter-dental fricatives, alveo-palatal fricatives, and alveolar liquids can be a challenge for Korean speakers in articulating them correctly. In addition to such

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obstruents in English, sonorant clusters of English can also be a burden for Korean speakers in the acquisition of accurate English pronunciation. When two sonorants of English such as nasals and liquids occur over a syllable or morpheme boundary, they are realized faithfully in the output. The articulation of such sonorant clusters is difficult for Korean speakers partly due to the interference of Korean phonology. In Korean, one of the sonorants in a sonorant cluster over a syllable boundary is easily subject to assimilation to the other sonorant and this phonological fact is transmitted to Korean speakers. Thus the main goal of this paper is to delve into the sonorant clusters of the two languages and find out the phonological factors that we can ascribe to the difficulty of Korean speakers in learning correct pronunciation of sonorant clusters in English. Based on such phonological factors, we will provide an analysis based on the Correspondence Theory (McCarty & Prince, 1995), which is the refined version of the Optimality Theory (Prince & Smolensky, 1993, 2004). We will also discuss the main reasons for the problems of learning pronunciation from the perspective of the constraint-based theory.

This paper is organized as follows. In section 2, we briefly present the systematic phonological difference between English and Korean. Section 3 presents the data for sonorant clusters in Korean and English, which is followed by the proposal before the analysis in section 4. Section 5 provides the constraints and their interaction for the analysis along with some discussion of pronunciation and English education. We will summarize the paper in section 6.

## II. PHONOLOGICAL DIFFERENCE BETWEEN ENGLISH AND KOREAN

There are a lot of differences between English and Korean in the phonological system such that they have different internal syllable structure and different syllabification (Avery and Ehrlich, 2003; Chung, 2001, Oh, 2004). In this section, however, we focus on the segmental differences between the two languages.[1] Some consonants of English do not have their counterparts in Korean. We regard them as the important factors for Korean speakers in their correct pronunciation of English because they function as a barrier for Korean speakers in acquiring English pronunciation. The English phonemes

[1] Citing Weinreich (1953), Wolfram and Johnson (2003, pp. 188-190) distinguish four types of interaction and interference from a phonological point of view in comparing the phonemes of one language with another. They are underdifferentiation, overdifferentiation, reinterpretation of distinctions, and actual phone substitution.

that do not exist in Korean are given in (1).

(1) English phonemes that do not exist in Korean

| Labio-dentals | Inter-dentals | Alveolars | Alveo-palatals |
|---|---|---|---|
| /f, v/ | /Π,Δ/ | /l, r, s, z/ [2] | /Σ,Ζ/ |

Since the Korean speakers are not familiar with the sounds given in (1), it is difficult for Korean speakers to articulate each of them. What makes it more difficult for Korean speakers is that a combination of sonorants in English which are composed of a liquid and nasal sequence, and a nasal and liquid sequence. The other possible cases of sonorant clusters are a combination of two liquids [r+l] and [l+r] over a syllable boundary. In this paper, we do not discuss nasal sequences over a syllable boundary because we can observe nasal clusters in Korean and they do not pose any critical problem for Korean speakers to pronounce them such as in [caN.mi] 'a rose' and [kam.mi.Po.un] 'sweet.' A problem arises in the combinations of nasal+liquid, liquid+nasal, and liquid+liquid of English because they maintain their manner feature in the output of English while the Korean counterparts are modified to satisfy the phonological requirements as in /silnΘ/ → [sil.lΘ] 'indoors,' and /sinla/ → [sil.la] 'Shinla dynasty.' Furthermore, the final sonorant combinations do not exist in Korean. The differences in phonological requirements over a syllable boundary between English and Korean can be a critical factor for pronunciation. In the next section, we present the relevant data for English and Korean.

## III. DATA

In English, sonorant clusters can occur over a syllable boundary with only few restrictions. Since the dorsal nasal stop /N/ is not allowed as the onset of a syllable, any clusters where the second half of them begin with it are prohibited in the language. We limit the sonorant clusters occurring over a syllable or morpheme boundary within a word in order to show the differences of phonological requirements between the two

[2] Based on the sound classification of Korean by Sohn (2001), the alveolar liquids /l, r/ in English are different from the alveo-dental /l/ and flapped [P] of Korean /l/ in the intervocalic position in that the former can only occur as a part of geminate of [l] over a syllable boundary and a coda element while the latter is the allophonic realization of the singleton /l/ between the two vowels such as /salam/ → [sa.Pam] *[sa.ram] 'a person.' However, when /l/ occurs word-initially, it is not realized as in [↔yk.t'o] 'weight-lifting' vs. [c$^{h}$a.Py↔k] 'enhance physical strength.' Likewise, the alveo-dental fricative /s/ in Korean is different from English /s/ in its place which is in turn implemented in its realization.

languages in terms of syllable boundary. We first present English clusters consisting of a nasal and liquid or a liquid and nasal.

(2) A nasal and liquid/A liquid and nasal combination in English

| | |
|---|---|
| [m+l] | Hamlet, calmly, harmless, farmland, dimly |
| [l+m] | almanac, hallmark, helmet, dalmatic, dolman |
| [m+r] | camry, comrade |
| [r+m] | fermant, Bermuda, dormant, charming, ermine |
| [n+l] | Henley, Finley, unlock, only, Dunlop, online |
| [l+n] | walnut, dullness, illness, Telnet, |
| [N+l] | seemingly, interestingly, increasingly, |

As shown in a nasal and liquid or a liquid and nasal sonorant clusters in English, the order of sonorants in the cluster is not specifically constrained. The following data represent the combination of two liquids in English.

(3) A retroflexed and lateral liquid/A lateral and retroflexed liquid

| | |
|---|---|
| [r+l] | barley, curly, similarly, girly, particularly |
| [l+r] | bulrush, chillroom, Kilroy, millrun, oil-rich |

The combinations of [r+l] or [l+r] show that the order of the sonorants is not limited in the internal sonorant clusters. The fact that there is no special requirement in the order of sonorants over a syllable boundary and sonorants are realized in the output without any changes, implies there is not much prohibition of sonorant clusters over a syllable boundary in English.

However, such freedom of sonorant clusters in Korean is rather constrained. Input sonorant clusters such as a nasal and liquid sequence are modified to a nasal and nasal cluster while clusters composed of a liquid and peripheral nasal appear identically in the output form. The relevant examples are given in (4). We do not include the clusters such as [m+r], [r+m], [r+l] and [l+r] because the retroflex /r/ does not exist in Korean. In the data, '.' indicates a syllable boundary.

(4) Sequence of a nasal and liquid and a liquid and nasal

| | | | | |
|---|---|---|---|---|
| /m+l/ | /kamli/ | → | [kam.ni] | 'supervision' |
| | /tamlon/ | → | [tam.non] | 'discourse' |
| /l+m/ | /py↔lmy↔N/ | → | [py↔l.my↔N] | 'a nickname' |
| | /malmi/ | → | [mal.mi] | 'time' |
| /n+l/ | /tanly↔n/ | → | [tal.ly↔n] | 'discipline' |

| | | | | |
|---|---|---|---|---|
| | /kwanlyo/ | → | [kwal.lyo] | 'bureaucrat' |
| /l+n/ | /silnΘ/ | → | [sil.lΘ] | 'indoors' |
| | /tʲlny↔k/ | → | [tʲl.ly↔k] | 'flat country' |
| /N+l/ | /sʲNli/ | → | [sʲN.ni] | 'victory' |
| | /kuNli/ | → | [kuN.ni] | 'consideration' |

The data show an interesting fact about sonority between the adjacent consonants over a syllable boundary. When $C_1$ of the sonorant cluster has higher sonority than $C_2$ such as in /l+m/, there is no change in the manner of articulation of the cluster constituents except for the /l+n/ sequence. However, when $C_2$ is higher in sonority than $C_1$, one of the sonorant undergoes a change in its manner feature. Another thing to note is that if a $C_1C_2$ sequence over a syllable boundary has rising sonority, there are two ways to mend this prohibited sonority sequence. One way is a type of assimilation, 'n-Lateralization' (Kim-Renaud, 1974/1991; Ahn, 1998) by which a nasal becomes a lateral [l]. The other is that a lateral /l/ changes to [n], which has been analyzed as 'Word-initial Avoidance' (Ahn, 1998). In this case, the liquid /l/ changes to [n] when it is preceded by other consonants except for /n/.[3] Such sound modifications do not occur in the sonorant clusters of English where each sonorant can almost freely occur over a syllable boundary. The differences between the two languages in the phonological processes over a syllable boundary can play as a barrier for the Korean speakers learning English. In what follows, we present the sonority scale and the homogeneous clusters divided by the different behavior concerning sonority requirement in clusters of Korean.

(5) Sonority scale (Selkirk, 1984)[4]

Vowels > Glides > Liquids[5] > Nasals > Fricatives/Affricates > Plosives

(6) Sonorant clusters in Korean

a. Falling sonority: [l+m], [l+n]

b. Rising sonority: [m+l], [n+l], [N+l]

[3] In this paper, we will not delve into the complex looking 'n-Lateralization' and 'Word-initial Avoidance' in Korean because this is not the focus of the study and readers should see Kim-Renaud (1974/1991) and Ahn (1998) for more detailed information and the analysis. For the assimilation processes over a syllable boundary, readers are also referred to Jun (1995), Davis and Shin (1999), Um (2003), and Seo (2007).

[4] The different 'Sonority Scale' has been proposed by others such as Vennemann (1972), Hooper (1976), Kirpasky (1979), and Hogg and McCully (1987).

[5] The sonority of liquids in English should be decomposed to *r>l* because of their interaction in the syncope process where an unstressed vowel can be syncopated when the newly formed consonant cluster has rising sonority between them. When sonorants occur at the left and the right side of the schwa such as in 'celery', the schwa can be deleted since the resulting [l.r] sequence in [sEl.rI] shows rising sonority. See Chung (2006) for more detailed analysis and information about syncope and sonority in English.

As we can draw from the data description, sonority between the two consonants in Korean is very important because it might trigger a sound modification when sonority rises from the first consonant to the second one in order to repair the rising sonority between the two sonorants. Based on the phonological differences between English and Korean, we propose reasons why Korean learners have trouble in acquiring correct pronunciation of sonorant clusters in English in the next section.

## IV. PROPOSAL

In this section, we propose why Korean speakers who are learning English have some difficulties in pronouncing some of the sonorant clusters over a syllable boundary. As we briefly discussed in section 2, there are systematic differences between the two languages and this can be a primary reason why Korean learners of English have some problems in pronouncing sonorant clusters. Since some of the English phonemes, which do not exist in the Korean language, are new to Korean speakers, they can trigger some learning problems. One good example comes from Avery and Ehrlich (2003, p. 140) who argue that Korean students tend to substitute /l/ for /r/ in initial position, producing 'light' instead of 'right'. They continue to state that Korean students may substitute what sounds like an /r/ or a flap /D/ for /l/ between vowels, producing 'firing' or 'fighting' for 'filing'. We can easily imagine that it will be more difficult for Korean speakers to pronounce a sequence of such English sonorant clusters than articulating singletons with which Korean speaker are not familiar. We propose that this is partly because sonority sequencing between $C_1C_2$ over a syllable boundary. In English, sonorants rather readily form a cluster over a syllable boundary, which is licensed by no sonority sequencing restrictions between medial $C_1C_2$. On the other hand, sonority sequencing requirement over a syllable boundary is strictly obeyed in the Korean language. In addition to this, among the clusters satisfying the sonority sequence requirement over a syllable boundary, the [l+n] sequence is banned in Korean phonology. The following examples show sonorant feature modifications when there is an [l+n] sequence even though it satisfies the sonority sequencing requirement in Korean. We repeat two of the examples from (2) and the others are from Ahn (1998) and Davis and Shin (1999).

(7) Sonorant modification in Korean: /l+n/ → [l+l]

| | | | |
|---|---|---|---|
| /silnΘ/ | → | [sil.lΘ] | 'indoors' |
| /tˈlny↔k/ | → | [tˈl.ly↔k] | 'flat country' |
| /pulnˈN/ | → | [pul.lˈN] | 'incapability' |
| /s↔lnal/ | → | [s↔l.lal] | 'New Year's Day' |

| | | | |
|---|---|---|---|
| /t$^{h)}$lni/ | → | [t$^{h)}$l.li] | 'denture' |
| /talnala/ | → | [tal.la.Pa] | 'moon land' |

As we can draw a generalization from the data in (7), the [l+n] sequence is totally banned in Korean. Except for this, if a cluster satisfies the sonority sequencing requirement from a medial $C_1$ to $C_2$, each consonant maintains their features in the output. Thus, sonority between the two medial consonants plays an important role as a trigger of sonorant modifications in Korean.[6] Naturally, we argue that one of the reasons why there are sound modifications at the medial syllable edges lies in the implementation difference of the sonority sequencing requirement. This is schematically presented in (8).

(8) Sonority over a syllable boundary
   a. English: Coda ≥ Onset, Coda ≤Onset (no preference for sonority)
   b. Korean: Coda ≥ Onset

Based on the proposal, we will analyze the data by putting forth some relevant constraints and their interaction in English and Korean.

## V. ANALYSIS

In this section, we provide a constraint-based analysis where all the phonological processes are explained by the interaction between faithfulness and markedness constraints. Generally phonological processes are triggered by a markedness constraint since it requires some modifications in the output if the input constituents do not observe the requirement specified by the constraint. For English sonorant clusters, we will

[6] We should note that there are some other types of analyses, which argue against the role of a sonority sequencing requirement called 'Syllable Contact' (Davis and Shin, 1999), which is originally due to Vennemann (1988), in Korean phonology. Seo (2007) points out some problems of the analysis, which resorts to the 'Syllable Contact' constraint to explain cross-linguistic sonorant cluster modifications because there are some languages such as Leti and Moroccan Arabic where sonorant clusters not occurring over a syllable boundary also undergo modifications. However, we employ the SYLLCON constraint in this paper since we are not dealing with cross-linguistic modifications in clusters. Furthermore, the analysis offered in this paper is different from Davis and Shin's (1999) analysis in that we are only dealing with sonorant clusters over a syllable boundary where rising sonority is only observed in [n.l]. This cluster, however, does not pose any problem for the analysis since [n.l] is not allowed in Korean phonology. On the other hand, Davis and Shin's analysis might face a problem when a cluster composed of a voiceless stop followed by a fricative such as in [mok.so.ri] 'a voice' which has rising sonority between [k] and [s]; This can be a problem because they are considering various types of consonant clusters over a syllable boundary.

employ the following constraints, which we adopt from Chung (2002).

(9) Constraints for sonorant clusters in English
   a. MAX-SEG: Every segment in the input has its correspondent in the output.
   b. DEP-IO: Every segment in the output has its correspondent in the input.
   c. SYLLCON: Rising sonority over a syllable boundary is prohibited.
   d. IDENT-IO(F): Correspondents between the input and the output should have identical features.

MAX-SEG requires the perfect corresponding relation between the input and the output in terms of their segment. If any part of the input segment does not appear in the output, it violates the constraint. DEP-IO also calls for the faithful segmental match between the output and the input. If a segment is inserted in the output, the inserted segment does not have its correspondent in the input, which in turn violates the DEP-IO constraint. SYLLCON is a constraint that specifies sonority sequencing between $C_1$ and $C_2$ over a syllable boundary. If the onset constituent in a following syllable has higher sonority than that of the coda in the preceding syllable, SYLLCON is violated. Finally, IDENT-IO(F) is a cover constraint which subsumes several Identity constraints such as IDENT-IO(LATERAL), IDENT-IO(NASAL), and IDENT-IO(RETROFLEX). This constraint belongs to the faithfulness constraint family but it is different from segmental faithfulness in (9a) and (9b) in that IDENT-IO(F) does not check its segmental correspondent but it values features of input against its output correspondent. Thus, if an input element does not have its correspondent in the output, the constraint is satisfied trivially.

In English, since each constituent of a sonorant sequence in the input appears in the output without any change, the faithfulness constraints such as MAX-SEG, DEP-IO, and IDENT-IO(F) should be ranked higher than SYLLCON. This indicates that the input and the output correspondence relations in terms of segment and feature should be preserved even at the cost of violating SYLLCON. Concerning the ranking among the faithfulness constraints, they do not show any particular ranking one from another. This ranking relation is presented in Table 1.

**TABLE 1**
**A nasal and liquid cluster**
**/dImlI/ → [dIm.lI] 'dimly'**

| /dImlI/ | MAX-SEG | DEP-IO | IDENT-IO(F) | SYLLCON |
|---|---|---|---|---|
| dI.mI | *! | | | |
| dI.m↔.lI | | *! | | |
| dIm.nI | | | *! | |
| ☞ dI.m.lI | | | | * |

The given constraint ranking eliminates the first three candidates because the first candidate crucially violates the MAX-SEG constraint by deleting the liquid /l/ in the output; the second candidate incurs a violation of DEP-IO by inserting a schwa in the output. The third candidate is suboptimal because the liquid /l/ in the input and its correspondent [n] in the output are not identical in their feature. The optimal candidate is the last candidate, which violates the lower ranked SYLLCON while it satisfies all the high ranked faithfulness constraints. The candidate violates SYLLCON because [l], which is $C_2$, is higher in sonority than [m], which is $C_1$, showing rising sonority over a syllable boundary.

Table 2 exhibits an example, which has falling sonority from the first to the second sonorant in the word medial position.

**TABLE 2**
**A liquid and nasal cluster**
**/dɚrm↔nt/ → [dɚr.m↔nt] 'dormant'**

| /dɚrm↔nt/ | MAX-SEG | DEP-IO | IDENT-IO(F) | SYLLCON |
|---|---|---|---|---|
| dɚ.r↔nt | *! | | | |
| dɚ.r↔.m↔nt | | *! | | |
| dɚr.r↔nt | | | *! | |
| ☞ dɚr.m↔nt | | | | |

Table 2 is almost identical with Table 1 in the evaluation of the candidates. The only difference in the optimal candidate in Table 1 and 2 is that the winning candidate in Table 2 fares better on SYLLCON than that of Table 1. The remaining non-optimal candidates from the first to the third violate MAX-SEG, DEP-IO, and IDENT-IO(F), respectively. The constraint ranking revealed in Table 1 and 2 implies that SYLLCON should be ranked low compared to the other faithfulness constraints in English because it should not play a critical role in the selection of the optimal form in order to reflect no

specific sonority requirement of sonorants over a syllable boundary.

We will next present a table, which shows a liquid cluster. Two liquid sonorant clusters such as /r+l/ and /l+r/ are not easy sequences for Korean speakers to pronounce since the Korean language does not have retroflexed /r/ and the singleton /l/ is realized as a flap intervocalically.

**TABLE 3**
**A liquid and liquid cluster**
**/mIlr↔n/ → [mIl.r↔n] 'millrun'**

| /mIlr↔n/ | MAX-SEG | DEP-IO | IDENT-IO(F) | SYLLCON |
|---|---|---|---|---|
| mI.r↔n | *! | | | |
| mI.l↔.r↔n | | *! | | |
| mIl.l↔n | | | *! | |
| ☞ mIl.r↔n | | | | * |

The optimal output is the final candidate and it satisfies all three high ranked constraints while violating the low ranked SYLLCON. The optimal candidate incurs a violation of SYLLCON because the retroflexed [r] is higher in sonority than the lateral [l] in English as briefly discussed in footnote 5. The remaining three candidates violate one of the three high ranked constraints; the first candidate fails to satisfy MAX-SEG, and the second and the third candidates violate DEP-IO and IDENT-IO(F) each.

As we have seen so far, sonorant clusters of English over a syllable boundary can be explained by the constraint interaction between the high ranked faithfulness constraints and the low ranked SYLLCON constraint. The established constraint ranking for English is given in (10).

(10) Constraint ranking for sonorant clusters in English
MAX-SEG, DEP-IO, IDENT-IO(F) >> SYLLCON

Based on the constraint ranking for the sonorant clusters in English, we now take on the analysis for the sonorant clusters in Korean. We will first apply the same constraint ranking revealed in English to Korean. Table 4 shows /m+l/ cluster which does not observe the sonority sequencing requirement of Korean over a syllable boundary.

**TABLE 4**
**A nasal and liquid cluster**
**/kamlI/ → [kam.nI] 'supervision'**

| /kamlI/ | MAX-SEG | DEP-IO | IDENT-IO(F) | SYLLCON |
|---|---|---|---|---|
| ☜ kam.lI | | | | * |
| ka.mI | *! | | | |
| ka.m͡.lI | | *! | | |
| kal.lI | | | *! | |
| ☞ kam.nI | | | *! | |

If we apply the constraint ranking used for the sonorant clusters in English, the actual output form indicated by the left pointing finger loses to the undesirable first candidate signaled by the right pointing finger. The other problem witnessed in Table 4 is that the fourth candidate fares equally with the optimal form, which implies that both should be selected as optimal if the first candidate is not there.

In order to solve this problem, we should permutate the relevant ranking such as IDENT-IO(F) and SYLLCON. In addition to this, we should decompose IDENT-IO(F) into more specific identity constraints such as IDENT-LATERAL and IDENT-NASAL. Decomposition of this identity constraint is motivated by feature sensitivity in medial sonorant clusters in Korean. In Korean phonology, peripheral nasals such as labial and dorsal nasals usually maintain their features when they are involved in a certain phonological process. On the other hand, coronal nasals are the usual target of phonological processes, which is reflected in the positional markedness hierarchy proposed by Prince and Smolensky (1993, 2004). Considering this, it is difficult to rank the two identical constraints IDENT-NASAL and IDENT-LATERAL because the former contains segments with both peripheral and coronal features while the latter has segments only with a coronal feature. In this paper, we give the priority to IDENT-LATERAL because it only changes to [n] when it occurs after a consonant other than /n/ (Ahn, 1998) while it maintains its feature when it occurs before a sonorant whose data were presented in (4). With respect to IDENT-NASAL, it is ranked lower than IDENT-LATERAL because the coronal nasal is readily modified into a feature of a neighboring consonant. In many examples of /l+n/ and /n+l/ sequences over a syllable boundary, they end up with a [l+l] cluster in the output. [7]

For a case where a sonorant cluster satisfies the sonority sequence requirement

[7] In some cases, the /n+l/ cluster is realized as both [l+l] and [n+n] in Korean. So the input /s↔nl͡N/ 'place name' is realized either as [s↔l.l͡N] for some speakers or [s↔n.n͡N] for other speakers. Some aspect of this phenomenon is discussed in Um (2003).

between the two sonorants such as /l+m/, we need a constraint that requires a faithful place feature between the correspondents. This IDENT-PLACE constraint will maintain the [l+m] cluster in the output so that the deviated forms from the input like [l+l] or [m+m] are prohibited in the output forms. Thus, IDENT-PLACE should dominate both IDENT-LATERAL and IDENT-NASAL since the segments with a lateral or nasal feature should be modified to meet the sonority sequence requirements between the two sonorants. The other constraint we introduce for the analysis is *ln/*nl (Chung, 2002), a markedness constraints which calls for a ban on the adjacent coronal sonorant sequence having a different manner over a syllable boundary (cf. Seo, 2007). This constraint is ranked higher than IDENT-LATERAL and IDENT-NASAL since either a lateral or nasal consonant should undergo some modification to avoid the marked coronal sequences. However, the *ln/*nl constraint is not in conflict with the other high ranked constraints such as MAX-SEG, DEP-IO, SYLLCON, and IDENT-PLACE. The newly introduced constraints and the decomposed IDENT-IO(F) along with the constraints repeated from (9) are presented in (11).

(11) Constraints for sonorant clusters in Korean
- a. MAX-SEG: Every segment in the input has its correspondent in the output.
- b. DEP-IO: Every segment in the output has its correspondent in the input.
- c. SYLLCON: Rising sonority over a syllable boundary is prohibited.
- d. IDENT-LAT: Correspondents between the input and the output should have an identical lateral feature.
- e. IDENT-NAS: Correspondents between the input and the output should have an identical nasal feature.
- f. IDENT-PL: Correspondents between the input and the output should have an identical place feature.
- g. *ln/*nl: Adjacent coronal sonorant sequences with a non-identical manner feature are not allowed.

Based on the ranking relation discussed above, we explain the same example used in Table 4 in the following Table 5.

**TABLE 5**
**A nasal and liquid cluster**
**/kamlI/ → [kam.nI] 'supervision'**

| /kamlI/ | MAX-SEG | DEP-IO | SYLL CON | *ln/*nl | IDENT-PL | IDENT-LAT | IDENT-NAS |
|---|---|---|---|---|---|---|---|
| kam.lI | | | *! | | | | |
| Ka.mI | *! | | | | | | |
| ka.mˌ.lI | | *! | | | | | |
| kal.lI | | | | | *! | | * |
| ☞ kam.nI | | | | | | * | |

In Table 5, the first two candidates are suboptimal because of their violation of SYLLCON and MAX-SEG, respectively. The first candidate has rising sonority between [m.l], which is against SYLLCON while the second one deletes [l] in the output violating the faithfulness constraint. The third candidate is not the optimal form due to its violation of DEP-IO since the inserted vowel does not have its correspondent in the input. The fourth candidate loses to the optimal final candidate because it incurs a violation of IDENT-PL by changing the input labial place feature to coronal. The optimal candidate only violates IDENT-LAT since its input lateral sonorant changes to a nasal sonorant in the output. However, this candidate emerges as the winning candidate because IDENT-LAT is ranked lower than the other high ranked constraints.

We now present a cluster that is not allowed in Korean phonology; /l+n/ and /n+l/ clusters are pronounced [l+l] in the output, which are constrained by the *ln/*nl constraint. The second cluster also violates the high ranked SYLLCON, which motivates the modification in the cluster. Likewise, the /l+n/ cluster is destined to be changed to [l+l] because of the pressure from the *ln/*nl constraint. Both clusters do not have any other strategies to use but to modify one of the elements because deletion or insertion strategies are filtered out by the faithfulness constraints.

**TABLE 6**
**A coronal nasal and liquid cluster**
**/tanly↔n/ → [tal.ly↔n] 'discipline'**

| /tanly↔n/ | MAX -SEG | DEP- IO | SYLL CON | *ln/*nl | IDENT- PL | IDENT -LAT | IDENT- NAS |
|---|---|---|---|---|---|---|---|
| tan.ly↔n | | | *! | *! | | | |
| tal.y↔n | *! | | *! [8] | | | | |
| ta.nˌ.ly↔n | | *! | | | | | |
| tan.ny↔n | | | | | | *! | |
| ☞ tal.ly↔n | | | | | | | * |

The first candidate is identical to the input but it violates the high ranked SYLLCON and *ln/*nl. So it does not qualify as the optimal form. The second candidate is not optimal either since it also violates the high ranked MAX-SEG and SYLLCON. The third candidate is eliminated as the optimal form due to the insertion of a vowel entailing the violation of DEP-IO. The fourth and the final candidates are interesting because they use different strategies to avoid the highly marked cluster in Korean. The former employs the nasalization of the lateral input, which is a type of progressive assimilation. But the resulting form fails to satisfy the low ranked IDENT-LAT constraint. On the other hand, the winning candidate uses regressive assimilation or lateralization of a nasal even at the cost of violating IDENT-NAS. However, the violation of this constraint is not crucial since this is the lowest ranked constraint. The constraint ranking established so far is given in (12).

(12) Constraint ranking sonorant clusters in Korean
MAX-SEG, DEP-IO, SYLLCON, *ln/*nl, IDENT-PL >> IDENT-LAT >> IDENT-NAS

Now we consider the ranking difference between English and Korean from which we can draw some implications why some sonorant clusters are difficult for Korean speakers to articulate. We repeat the constraint ranking for English sonorant sequences in (13).

(13) Constraint ranking for sonorant clusters in English
MAX-SEG, DEP-IO, IDENT-IO(F) >> SYLLCON

[8] We regard the syllable or morpheme initial glide as a consonant and it naturally is the onset of the syllable. Thus, the second candidate violates SYLLCON since there is rising sonority between [l.y].

A comparison of the two rankings reveals that SYLLCON is promoted from low ranking in English to high ranking in Korean. This reflects the sonority sequence requirement difference between the two languages. The next difference is that the decomposition of the IDENT-IO(F) constraint into IDENT-LAT and IDENT-NAS, which are actually ranked differently from each other. This shows that the usual target of assimilation over the syllable boundary is the nasal rather than the lateral. We argue in this paper that the trigger of assimilation is the sonority sequence requirement between the sonorants. The newly added constraints such as *ln/*nl and IDENT-PL have their own ramifications. Thus, the former along with SYLLCON requires the modification of /l+n/ and /n+l/ sequences. On the other hand, the latter calls for the same place feature between the input and the output, which licenses sound modifications from /n/ to [l] and from /l/ to [n], but does not allow changes from peripheral sonorants to coronal ones or vice versa.

Based on the differences between the two languages, we can assume why Korean speakers have difficulties articulating some sonorant sequences in English. We think that Korean speakers are not familiar with the constraint ranking of English such that the constraint ranking of Korean with respect to the sonorant clusters acts as a barrier to the acquisition of pronunciation of English sonorant clusters. Especially, the effect of *ln/*nl and SYLLCON is acute in that the Korean language does not allow such clusters but there are many examples in English that have medial [l.n] and [n.l] as we presented in (2). SYLLCON also has far a reaching effect as well for Korean speakers because there are English sonorant clusters disobeying it such as [m.l], [n.l], [N.l], and [l.r] even if we confine the examples only to sonorant clusters, let alone clusters consisting of an obstruent and a sonorant. Since this is the case, Korean learners of English should know each sonorant sound production mechanism first before they practice a sonorant cluster (cf. Avery & Ehrlich, 2003, p. 140; Yavaş, 2006, pp. 193-197). If they distinguish /r/ from /l/, for example, the clear pronunciation of each sonorant will be transferred to them in their practicing of sonorant clusters. On the other hand, English teachers should have some information about “errors” which Korean learners commonly make because it often the case that speakers of a native language background often make the similar kind of “errors” when they are learning a foreign language (Wolfram & Johnson 2003). If help from the teachers is in harmony with the efforts from the students, it can surely facilitate the learning of English pronunciation by Korean speakers. In the next section, we will conclude the analysis of this paper.

## VI. CONCLUSION

In this paper, we try to find possible reasons why Korean speakers have problems pronouncing some sonorant clusters in English. We think that it is too vague to argue that having some problems in learning English pronunciation is natural because English is a foreign language. Thus, we pointed out that there are some systematic differences between the two languages concerning phonemic inventory. The difference in phonemes in English and Korean is a fundamental problem; the other important problem is that over a syllable boundary, a sonorant cluster is realized faithfully in English whereas it is subject to modification if it does not meet some phonological conditions in Korean. From the Optimality Theoretic point of view, we argue for the role of SYLLCON along with other constraints such as *ln/*nl. The ranking difference of SYLLCON between the two languages poses problems for Korean speakers in learning pronunciation of sonorant clusters. The high ranking of SYLLCON and *ln/*nl in Korean interferes with Korean speakers in learning pronunciation and they are somewhat prone to assimilate a sonorant to a neighboring sound to meet such highly required phonological conditions in Korean. One issue, which remains to be addressed is that it is worthwhile to experiment with different combinations of sonorant clusters over a syllable boundary to propose a scale of difficulty for Korean speakers to pronounce them. We leave it for future studies.

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**Examples in : English**
**Applicable Languages: English**
**Applicable Level: Secondary**

Chin-Wan Chung
Department of English
Chonbuk National University
664-14 Duckjin-dong, Jeonju city
Jeollabukdo 561-756, S. Korea
Tel: (063) 270-3205
Fax: (063) 270-3201
Email:atchung@hanmail.net

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