# SONORITY HIERARCHY
# IN SEGMENTAL PHONOLOGY OF KOREAN*

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In Sound Pattern of English, Chomsky and Halle (1968) proposed the phonological theory in which distinctive features are considered the smallest phonological units.  They introduced Markedness Theory into the generative phonology in order to establish generative grammer with explanatory adequacy and to explain phonological processes economically.  This means that a linguistic theory contains substantive and formal universal which require the linguist to construct grammars which reflect the phonetic motivation of grammatical processes.  According to the Markedness Theory, any marked rules are judged as unnatural ones by universal principles.  Any phonological rule should be formulated so that the rules can account for phonological phenomena in the most simple and appropriate way and at the same time give the most significant generalization.  To put it in another way, the naturalness of a series of segments, metrical structures and phonological changes, which are described by rules, can be determined by the number of marked features.

In linguistic study, it is important to discover some universal principles working in natural languages.  Therefore, it may become insignificant to describe a language specific phonological processes and phenomena though they are considered as the most general tendencies in a given language.

But this surely misses the point. Any language has its own particular dynamics in every aspect that have played, play and will play crucial roles from a diachronic or synchronic point of view. This means that the rules that generate or preserve the most preferable phonological structures are also natural from the universal point of view ; that is, a sequences of segments, stress pattern, etc.. Without the description of a languages' specific features and processes, we cannot find a common nature or significant differences among natural languages. According to this line of the thought, we will study here one of the most important phonological dynamics in Korean phonology. This study will enable us to understand what differences there are between universal principles and language specific tendencies in Korean language. Two kind of phonological scale might be considered as useful for the aim of this study. One is so-called sonority hierarchy ; that is, the hierarchy that depends on the phonetic nature of segments. The universal hierarchy[1] determined by phonetic observations will be slightly modified by the analysis of the relationship among segments and of the phonological processes that work in Korean, so that we can determine which segmental preference is working or which rules should be considered most natural, in Korean, though it is not exactly coincident with universal hierarchy. The other is a strength scale of phonological segments which is decided through the analysis of phonological phenomena in a given language. With the scale of each language, we might make up a universal strength scale of each language that plays an important role in determining a syllable structure and in resyllabifying derived sequences of segments. We will discuss the role of sonority hierarchy in Korean phonology.

## 1.0 SONORITY HIERARCHY

At first we must note that sonority hierarchy is determined independent of phonological materials of any particular language. In this section, we shall determine the sonority hierarchy in Korean consonants that is derived from the universal sonority hierarchy, since the number of consonants differs from language to language. Conceptually, sonority is considered higher in vowels than in consonants. Thus basically, stop consonants are less sonorous than liquids and nasals. Among non-syllabic segments, glides are the most sonorous segments, of course. Our sonority hierarchy is defined on the level of phonology, but not on the level

of phonetics or acoustics.

Hankamer and Aissen (1974) analyse the sonority hierarchy for Pali language and their results are given as follows :

(1)  Stops  s  nasals  l  v  y  r  vowels
       1    2    3     4  5  6  7    8

From these results, we can say that the sonority hierarchy in a particular language could be different, though slightly, from an a priori hierarchy as it is for some consonants.   It is this difference that indicates the important features of a given language.   Thus we can find that such segments play a significant role and are marked segments from universal viewpoint.

In Korean we can find the following nasalization cited in (2) :

(2)  [+cons] → [+nasal] / ____[+nasal]

ex.  aphmatang [ammadaŋ],   papmas [pammat'],   tit＋nin＋ta [tinninda]
     pathmæki [panmæki],   nah＋nin＋ta [nanninda],   takk＋ne [taŋne]
     puəkh＋mun [puəŋmun],  us＋ne [unne],  iss＋ne [inne],  cəcməki[cənməgi]

This nasalization proceeds regressively.   A nasal consonant is specified as [+ syllabic] and can function as a syllabic like vowels.   This means that the nasal has high sonority because vowels are analysed as the most sonorous segments.   Thus nasalization can be said to be a phonological change that makes a segment more sonorous.   Furthermore, Korean has an assimilation called lateralization exemplified in (3) below.   The examples in (3) tell us that this change makes a more sonorant segment according to the scale of sonority shown in (1).   In other words, these two processes both proceed towards an increase of sonority.

(3)  n → l / l___        or  n → l / ___l

ex. charna [challa],     kinroca [killoja]

Now we will consider another nasalisation in Korean as follows :

(4)  l → n / [+ cor, + nasal]___

ex. kamro [kamno], congro [coŋno], cungryək [cuŋnyək'], kongro [koŋno]

As seen from this, the change makes a segment less sonorous.   Note that this pho-

nological process is called progressive assimilation, while the one cited in (2) and (3) is referred to as regressive assimilation. This observation suggests that a progressive change results in less sonorous segments and a regressive change generates more sonorous segments. This might reflect the fact that a regressive phonological change is universally unmarked within a root.

Next we will examine more interesting examples showing so-called reciprocal assimilation. In this case there is a problem with which rule to apply first, progressive or regressive. The examples are as follows :

(5)　ex. tokrip [tonnip′], pəpryəng [pəmnyəŋ], matryangpan [mannyaŋban],
　　　picryang [pinnyaŋ], myəchryang [myənnyaŋ]

The examples show that the progressive process proceeds to [- sonorant] and the regressive one towards [+ sonorant], as we could predict. We can assume that there is a principle governing phonological changes in Korean that can be stated on the sonority hierarchy. Although the progressive assimilation might be considered to be followed by the regressive one, a more interesting fact is that this sound change can be also accounted for by sonorant hierarchy. This tendency found in the above case is observed in so-called irregular verb and adjective conjugations that have already been established historically. This morphonological alternation occurs regressively and more sonorous segments, vowels, are surfaced. The examples are illustrated in (6) :

(6)　Irregular verb conjugation
　　　top + ta → top + ca
　　　　　　　tou + pnida [toumnida]
　　　　　　　tou + myən
　　tit + ta → tit + nin　　[tinnin]
　　　　　　　tir + əto　　[tirədo]
　　　　　　　tir + myən

Next we consider slightly problematic case. As seen in the following examples in (7), the sequence of nasal consonants / n+n / changes into the sequence of liquids / 1+1 / between vowels. The following examples may be cited :

(7)　mannyən [mallyən]　　kwənnyən [kwəllyəm]

The change involves two different phonological processes, assimilation and dis-similation.　The first change is dissimilation whether it occurs regressively or progressively.　If the regressive dissimilation is assumed to surface / l / first, the progressive assimilation produces a more sonorous segment / l / from / n / and this result is against our prediction.　In this case, our sonorant hierarchy can not predict that the first process is progressive dissimilation, since the progressive change produces a more sonorant segment / l / against our expectation.[2] This assimilation can be explained by assuming that the segment [l] has the same position as [n] or at least stand in the position next to [n] in the sonority scale in Korean language.　But the assumption that both segments are placed on the same position should be regarded as ad hoc and cannot be allowed by universal principle, since Korean has other nasal consonants grouped with the segments [n].　Now we can assume that the segment [n] should place next to [l] on the sonority scale, separating from other nasal consonants.　This is supported by the constraint on a word initial segment in this language exemplified in (8).　According to this assumption, we may get more sonorant segment even by progressive change if there is very close phonological status between segments as between [n] and [l] in Korean.

(8)　a.　/ l / → / n / / __[$^{+V}_{-high}$]　　rayəl [nayəl]

　　b.　/ n, l / → ø / __ i, y

　　　ri [i]　but　tori [tori]　　nyə [yə]　but　sonyə [sonyə]

From the above discussion, the directionality of some phonological changes like assimilation can be shown in a significant way by means of the sonority hierarchy. The sonority hierarchy might play some part in phonological analysis and description.　If so, phonological theory is enriched by incorporating the hierarchy in some formal way.

　Next we must proceed to discuss what influence the hierarchy has on other phonological phenomena in Korean.　First we find the deletion of a segment illustrated in (9).　This is also a very interesting phenomenon form the hierarchical viewpoint.

(9)  1→ φ / __ [+ cons, +ant, +cor] (i.e. /n, c, t, s/)

    ex.  sornamu [sonamu], purnapi [punapi], murcawi [mucawi], marso [maso],
        [pusap'], tartari [tatari]

    s → φ / __ V

    ex.  nas + ko → na + asə, is + ta → i + imyən

In Korean, the liquid is deleted through the word formation, and the deletion takes place regressively. In (9a), / l / is deleted before a [+ cor] consonant, and on the other hand, / s / is deleted before a vowel in (9b). Apparently both change are contradictory to each other from the point of view of the sonority hierarchy. From detailed observation of examples in (9), however, it can be seen that there remain more sonorant sequences and open syllables after these two segments are deleted. In general, we can say that regressive changes create more sonorant sound sequences within words.

    There is a unique phonological process, so-called tensification or glottalization. Tensification is a process in which stop consonants change into tense or glottal consonants after consonants or vowels. This never fails to occur after a stop consonant and in some cases its consonant completely assimilates to the resultant. This complete assimilation frequently occurs on phonetic level. There seems to be a kind of dynamic to the affected consonant, that is to say, the strength in influence as an environment. Let's look at the following examples :

(10)  a. kukyək [kugyək'] "formality"
         sirkyək [silkkyək'] "disqualification"
         səngkyək [səŋgyək'] or [səŋkkək'] "establishing formality"
     b. samucək [samujək'] "businesslike"
         yangcək [yaɲjək'] "puantative"
         sutongcek [sudoɲccek'] or [sudoɲjək'] "passive"
     c. cunsang [cunssaŋ] "a stone-stand in front of a tomb"
         kyəngsang [kyəŋsaŋ] "a stand for sutras"
     d. piparam [pibaram] "a wind and rain"
         nunparam [nunpparam] "a wind and snow"
     e. anpang [anppaŋ] "an inner room"
         naepang [næban] "an inner room"

f. song‿ən [soŋjən] "electric supply"

soncenting [sonccendih] "a flashlight"

sucen [sujən] "the generation of electricity by water power"

These examples show the hierarchy among the segments functioning as the environment of the tensification as follows:

(11)　Vowels　m, ŋ　n　l　stops

　　　　　1　　　2　3　4　　5

This hierarchy means that tensification occurs more often after stops than after a liquid and more frequent after / n / than after vowels. This phenomenon also tells us that [l] should be placed next to [n] and [n] should be separated from [m, h] forming a natural class with it. In tensification there seems to be certain semantic factor that governs the occurrence of tense consonants through that phonological process. Again we can say that progressive change surfaces less sonorant segments because tensification itself can be regarded as progressive process of sound change. The tense consonants can be said to be less sonorous than non-aspirate stops, since they have a closure in the glottis. We can also say that tensification prevents the consonants in the environment from being intact.

We will proceed to discuss another deletion shown in the consonant clusters. There are some consonant clusters appearing at the end of a word or within a word. Korean language cannot allow a sequence of more than two consonants in the final position and a sequence of more than three consonants in the middle of a word in the surface phonetic form. Therefore, one consonant must be deleted if such two or three consonants appear in the underlying form. We can call this deletion of a consonant cluster simplification. Some examples are cited as follows:

(12)　a. əps + ta [əp'ta], nəks [nək'], tors [tol], harth + ta [haltta], anc + ta [an-
　　　　tta], sirh + ta [siltha], manh + ta [mantha]
　　　b. irk + ta [ik'ta], cərm + ta [cə : mtta], nərp + ta [nəp'ta], irph + ta [ip'ta]

In (12b) consonants in a higher position on the sonority scale are deleted and in (12a) consonants in a higher position on the sonority scale remain. Moreover, [+ cor] consonants are deleted if two consonants are within two stages on the so-

nority hierarchy.   Now we can assume the following sonority hierarchy for Korean that is almost in accordance with the universally posited hierarchy :

(13)               stops   c, ch   s   h   m,  n   r(1)   y, w   vowels
                     1        2     3   4   5   6    7      8       9
                   _____

           tenses  aspirates  nonaspirates
             1        2            3


## 2.  STRENGTH HIERARCHY

In this section we will discuss the strength hierarchy of consonants that was proposed by Vennemann in his exciting article (1972b).   This hierarchy has a particular language dependent nature because it is purely deducted by the analysis of the phonological phenomena in a given language.   The strength hierarchy, therefore,  has the same characteristic as the closure principle in Korean that was first established by C—W, Kim (1972).   According to Vennemann, the following criteria are used for determining the relative strength among consonants.

(14)   A ; Consonant weakening process is : A segment X is said to be weaker
             than a segment Y if Y goes through an X stage on its way to zero.
       B ; Strengthening refers to the reinforcement of a segment, as, for example
             tensification of a consonant in Korean.

The criteria (14) is distributional criteria and these are considered as well-motivated principles.   Thus we will discuss the relative strength of Korean consonants by using (14).   First we notice that tense consonants are not aspirated and are not voiced.   From this,  we can decide that tense consonants are the strongest consonants among stops.
According to this criteria,  nonaspirate consonants are the weakest ones among Korean stop consonants.   The criteria in (13) give a consonant [s] the position of the strong consonant next to stop consonants,  since [s] is never voiced between voiced segments.   We, however, cannot make a clear-cut desicion which consonant is stronger,  [s] or [c].   In the position after [h],  [c] is changed into aspirated consonant [ch].   From this, [s] is able to be said to be stronger than [c].   In Korean,  the weakening occurs preconsonantally,  word-finally,  and intervocalically,

while the strengthening does only postconsonantally. We can consider progressive nasalization and tensification as the phonological processes of strengthening. On the other hand, the weakening can be found in the case that obstruents become implosives in word-final or preconsonantal position. According to the above definition of weakening and strengthening, segments [m] and [ŋ] are stronger than [r(1)], and [n] is weaker than or at least has equal strength to [r(1)]. Since [y] and [w] are frequently lost in homorganic environments, they are considered as the weakest segments.

From the above observations, the consonants of Korean can be arranged along a strength scale as follows :

(14)  pp, tt, kk   ph, th, kh   s   p, t, k   c, ch   h   m, h   n, r(1)   y, w
          9              8         7      6        5     4     3        2        1
          ←——————— strength

Given the strength scale of Korean consonants, the consonant-cluster simplication can be described in the following :

(15)   a. As to the clusters in (8)a, the relatively weaker consonants remain.
       d. As to the clusters in (8)b, the relatively stronger ones remain.

In the case of the consonant-cluster simplification, we can also say informally that the simplification in (8)a can be predicted by a condition as follows, using the feature specification :

(16)   (8)a. The second consonant is deleted if it is [+ cons, + cor] or 'h'.
       (8)b. The first consonant is deleted if the second one is [− cor].

In the case of / namk /, however, it is pronounced as [nam]. This simplification can be accounted for by strength scale. Apparently the strength scale shows the best and most general relationship among obstruents, and we can explain most of the phonological phenomena in Korean elegantly. However, we must note that the strength scale can be established only by the analysis of the phonological processes in a given language.

## 3.0 CONCLUSION

In this paper, sonority hierarchy plays an important part in Korean phonology and can indicate that some phonological processes are marked in a given language or some are universal. Recently sonority hierarchy is used as a kind of convention for the placement of syllable boundary. We could indicate that the concept of "sonority" is significant in segmental phonology, though we could not formulate the sonority hierarchy in formal way. Thus we must find the way to incorporate the concept into generative phonology. Strength hierarchy should be language-specific in nature and functions as a determinant in constructing syllable structure. From our discussion, the phonological processes proceeding to create a more sonorous segment might be natural tendency in Korean phonology. This trend is also shown by the existence of the following historical sound change in Korean language ;

$p > b > \beta > w$ or $\phi$

$k > g > \gamma > \phi$

$t > d > r$

$s > z > \phi$

## NOTES

1. According to Heffner (1952), this hierarchy is roughly defined as follows :

   | Voiceless C | Voiced C | nasals | l | r | glides |
   |---|---|---|---|---|---|
   | C | 2 | 3 | 4 | 5 | 6 |

2. In some cases that / l / stands before / n /, / n / changes into / l /. For example, / chalna / is realized as [challa]. We can find this unpredictable sound change in (8), but it should be considered as the output form derived by morpheme structure condition.

3. For detailed discussion, see Hirano (1980).

4. We can suggest that palatalization proceeds regressively and generates a more sonorous segment because affricates are more sonorous than stops. Aspiration of consonants lowers their degree of sonority.

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