

words, although the frequency effect is statistically significant only when the resulting change is phonetically unmotivated by the segmental context. In view of the cross-linguistic generalization that analogically motivated changes tend to affect low-frequency words before high-frequency words (Schuchardt 1885, Phillips 1984, Bybee 2001), the current finding provides supporting evidence for the proposal that the change is analogically motivated.

2. Background in Korean Phonology

The phoneme inventory of Korean is provided in Table 1. Coronal obstruents in Korean have three-way laryngeal contrasts (lax, aspirated, and tense) as well as three-way manner contrasts (stops, affricates, and fricatives). These contrasts, however, are completely neutralized to [t] in coda position as shown in (1). Another process germane to our discussion is the affrication of stem-final coronal stops before an *i*- or *j*-initial suffix (H. Kim 1997). For example, the verb 'to rise' has a stem-final /t/ but when the nominalizing suffix *i* is attached, the stop is affricated: *tot-a* 'to rise', *tot-im* 'rising' vs. *hæ-tot-s-i* 'sunrise'. Finally, plain stops and affricate are realized with voicing in intersonorant position (Jun 1993). For example, *tot-a* 'to rise' is realized as [todɑ] with the voicing of an intervocalic stop.

p, p <sup>h</sup> , p'	t, t <sup>h</sup> , t'	i	ɪ	u
	ts, ts <sup>h</sup> , ts'	ɛ	ʌ	o
	s, s'	h	æ	ɑ
m	n	ŋ		
	l/r		j, w	

Table 1. Phoneme inventory of Korean

- (1) Coda neutralization: t, t<sup>h</sup>, (t'), ts, ts<sup>h</sup>, (ts'), s, s' → t / \_\_ coda
- (2) Affrication in derived environments: t, t<sup>h</sup> → ts, ts<sup>h</sup> / \_\_ (h) / i / j
- (3) Intersonorant voicing: p, t, k, ts → b, d, g, dz / [+voice] \_\_ [-voice]

3. Overview of Data<sup>1</sup>

Many nouns that used to end in /t/ or /ts/ earlier in the history of the language have completely changed over to /s/-final nouns. For example, the locative form of 'brush' used to be *put-εj* (15C) with final [t] but has since changed to *pus-ε* (18C~). Other nouns that have changed over to /s/-final nouns are listed in (4a). For all other nouns ending in a coronal obstruent that have not completed the change, an optional variant with final [s] is

<sup>1</sup>The data discussed in this section are drawn from Kwak 1984, J. Choi 1986, Ko 1989, H. Kang 1993, and M. Kim et al. 1997.

# Sound Changes Affecting Noun-Final Coronal Obstruents in Korean

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1. Introduction

In Korean, nouns that used to end in a coronal obstruent, /t/, /ts/, /ts<sup>h</sup>/, or /t'/, have either changed to /s/-final nouns or currently show an optional variant with final /s/. While some argue that these changes are phonetically motivated (T. Choi 1977, H. Kim 2001), others argue that these changes are analogically motivated (Ko 1989, Hayes 1998, Albright 2002).

The current paper provides a systematic survey of patterns of variations in these nouns based on well-formedness judgment data gathered from native speakers of Korean and frequency data gathered from an on-line corpus. It is demonstrated that overall, high-frequency words tend to be more resistant to the innovative /s/-final pronunciations than low-frequency

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found. For example, the accusative form of 'milk' is variably realized as *tsats-il* or *tsas-il*. For *t<sup>h</sup>-il*-final nouns, there is an additional variant with final [ts]. For example, the accusative form of 'red bean' is variably realized as *p<sup>h</sup>at<sup>h</sup>-il*, *p<sup>h</sup>at<sup>h</sup>-il*, or *p<sup>h</sup>as-il*. The nouns that currently show such variations are listed in (4b) and (4c). All nouns in (4) are still pronounced with a final [t] in isolation form due to coda neutralization.

- (4) a.  $t \geq s$ : *pus* 'brush', *kas* 'hat', *nas* 'sickle', *mos* 'nail'  
 $t \geq ts \geq s$ : *pas* 'friend', *tis* 'meaning', *kos* 'place'  
 $ts \geq s$ : *tus* 'neighbor', *kis* 'collar', *kas* 'exorcism', *soykos* 'ice pick', *ojas* 'plum'
- b.  $ts \sim s$ : *pits* 'debt', *nats* 'day', *tsats* 'milk', *tsots* 'male genitalia'  
 $ts^h \sim s$ : *pits<sup>h</sup>* 'light', *nats<sup>h</sup>* 'face', *k'ots<sup>h</sup>* 'flower', *tats<sup>h</sup>* 'trap', *suts<sup>h</sup>* 'coal', *tois<sup>h</sup>* 'sail', *juts<sup>h</sup>* 'a traditional game played with sticks'
- c.  $t^h \sim ts^h \sim s$ : *pjat<sup>h</sup>* 'warmth of the sun', *mit<sup>h</sup>* 'bottom', *pat<sup>h</sup>* 'field', *k'it<sup>h</sup>* 'end', *p'at<sup>h</sup>* 'red bean', *soi<sup>h</sup>* 'pot', *kat<sup>h</sup>* 'outside', *kjat<sup>h</sup>* 'side'

Any analysis of these changes in Korean nouns also needs to account for the behavior of loanwords. When an English word is adapted with a final coronal stop in isolation form, the noun is realized with a final [s] before a vowel-initial suffix. For example, 'David' is adapted as *teipit* and is inflected as *teipis-i* (NOM), *teipis-il* (ACC), etc.

#### 4. Analogy to a Dominant Pattern

The current section reviews a proposal that the change to /s/ in noun-final coronals is motivated by analogy to other /s/-final nouns, which are the most common among coronal obstruent-final nouns (Ko 1989, Hayes, 1998, Albright 2002).

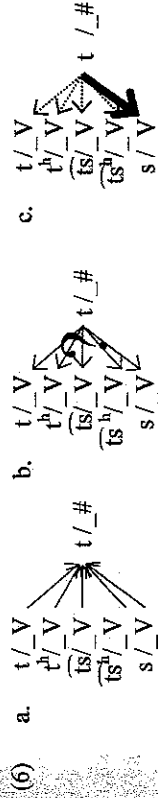
In Korean, noun stems can stand alone without a suffix, and it has been argued that the isolation form of nouns has a salient status such that various cases of paradigm leveling select the isolation form as a base, as the examples in (5) demonstrate (cf. Kenstowicz 1996). In other words, learners of Korean seem to identify the isolation form as a 'base', from which other forms in the paradigm are derived.

- (5) 'knee' *murip#*, *murip<sup>h</sup>-i* > *murip#*, *murip-i* &  
 'chicken' *tak#*, *tak-i* > *tak#*, *tak-i*  
 'tree' *namo#*, *namk-i* > *namu#*, *namu-ka*

When it comes to coronal obstruent-final nouns, the basehood of isolation form poses an especially serious challenge to the learner. Due to coda

<sup>2</sup> Some dialects still show *t'is* and *kois* for 'meaning' and 'place' (Kwak 1984).

neutralization, all coronal obstruent-final nouns are realized with a final [t] in isolation form, as shown in (6a). But, due to the salient status of the isolation form, learners take the isolation form, where all the contrasts among different coronal obstruents are neutralized, as a base and have to figure out the correct form of the noun before a vowel-initial suffix, as schematically illustrated in (6b).<sup>3</sup> It turns out, however, among nouns that end in a coronal obstruent, /s/-final nouns—that is, nouns that show alternation between a prevocalic [s] and a word-final [t]—are the most common. Therefore, the choice of final obstruent in prevocalic forms is not as random as in (6b) but [s] is more likely to be a correct choice than others, as illustrated in (6c).



As Hayes (1997) puts it, a language learner seems to 'seize upon generalizations that are statistically useful, albeit imperfect [emphasis original], in an attempt to improve her ability to guess the unknown inflected forms of known stems.' In other words, a learner of Korean reanalyzes the alternation introduced by coda neutralization as a mapping from an isolation form, with a final [t], to prevocalic forms, with a final [s]. The new mapping constraint/rule is extended to other nouns that are not originally /s/-final, resulting in the wholesale change of all nouns ending in a coronal obstruent to /s/-final nouns.

#### 5. Frequency of Use and Pattern of Lexical Diffusion

There is a fairly well-established generalization that analogically motivated changes and phonetically motivated changes propagate through the lexicon in different fashions (Schuchardt 1885, Phillips 1983, 1984, 2001, Bybee 1985, 2001, Bybee & Hopper 2001). Analogically motivated changes tend to affect low-frequency words before high-frequency words because the latter form strong mental representations and resist changes motivated by analogy to other forms. On the other hand, phonetically motivated changes tend to affect high-frequency words before low-frequency words because these changes progress with each use of the word, and therefore, the more

<sup>3</sup> Anecdotal evidence from the speech of my child supports the assumption that the isolation form of these nouns serve as a base for the paradigm. /os-in/ [otim] (cf. adult: [osin]) 'clothes TOP'; /nes-ita/ [netita] (cf. adult: [nesita]) 'four COP'. The difference between the child's grammar and the adult's grammar is that the analogical constraint ( $t \_ / \_ \# \rightarrow s \_ / \_ V$ ) has not yet been formed, or has not gained a salient enough status in the child's grammar.

frequently a word is used, the more advanced the change is. For example, many English irregular past forms are regularized by analogy to other regular verbs in the language (*wept* > *weep*) but the analogical change fails to affect high-frequency forms (*kept*, *\*keept*) (Bybee 1985). On the other hand, /d/-deletion in American English affects high-frequency words at a higher rate than low-frequency words (*told* vs. *feit*) (Bybee 1997).

We can apply this diagnostic to test the proposal that the change to [s] in Korean nouns is analogically motivated. As it turns out, the innovative [s] pronunciation is not available to all forms of all nouns to the same degree. In particular, it has been repeatedly observed that locative forms of nouns with the meaning of location or time are more resistant to the change than others (B. Lee 1975, T. Choi 1977, J. Choi 1986, K. Lee 1986, Ko 1989, H. Kang 1993). For example, the noun 'place', which used to end in [t] in the seventeenth century (*kot-ol* 'place, ACC', *kot-ɔj* 'place, LOC') maintain the final stop only in the locative form but not in the other prevocalic forms in the late nineteenth century Colla Dialect (*koſ-il* ~ *kos-il* 'place, ACC', *kot-ɛ* 'place, LOC') (J. Choi 1986). It has also been suggested that these forms resist innovation because they are fossilized due to their high frequency of occurrence. This observation fits in very well with the proposal that the change is analogically motivated. To verify the validity of the previous observations, I conducted a more systematic investigation into the correlation between frequency of use and rate of change.

## 6. Data Gathering

Since the change to [s] is a change in progress, it is assumed that the rate of change in different words can be measured through native speakers' wellformedness judgments for the innovative [s]-final pronunciations—namely, the more advanced the change to [s] is for a given word, the higher the wellformedness ratings for a [s]-final pronunciation will be. I selected sixteen nouns in common use that end in one of three coronal obstruents, which all show optional variants with a final [s]. The nouns are listed in (7). These nouns are combined with seven inflectional suffixes that begin with one of three vowels, listed in (8). 112 sentences containing each of the noun + suffix combinations (16 × 7) are made up. Each sentence is paired with one of five target pronunciations for the final coronal obstruent (*t*, *t̃*, *t̃s*, *t̃s̃*, and *s*), resulting in 560 entries. These sentences were presented to eight native speakers of Korean in *Hangu*<sup>4</sup> with the intended

<sup>4</sup> Currently, the standard orthography of Korean adopts a morphophonemic system and therefore, orthographic representation does not reflect the surface pronunciation of these nouns but more faithfully represent the historically correct pronunciations of these words. Therefore, the use of orthographic stimuli likely biases the speakers to be more conservative in their

pronunciation also presented using *Hangu* in square brackets. All subjects had postgraduate education and consider themselves primarily a speaker of the central dialect. Subjects were asked to rate the 'goodness' of the target pronunciation between one (bad) and four (good) based on how they or others in their speech community actually speak, rather than based on what they think should be the correct pronunciation. In order to ensure that the subjects understood the nature of the task, fourteen practice entries were given which involved other cases where the prescriptive pronunciation and actual pronunciation of speakers are known to diverge. The order of the sentences was semirandomized to prevent related sentences from occurring close to each other. Subjects were specifically asked not to go back to earlier entries to make corrections. A sample entry is given in (9).

- (7) *t̃s*: *p̃it̃s* 'debt', *ñat̃s* 'day', *t̃s̃at̃s* 'milk'  
*t̃s̃*: *p̃it̃s̃* 'light', *ñat̃s̃* 'face', *k̃ot̃s̃* 'flower', *t̃at̃s̃* 'trap', *s̃ut̃s̃* 'coal'  
*t̃*: *p̃j̃at̃* 'warmth of the sun', *m̃it̃* 'bottom', *p̃at̃* 'field', *k̃it̃* 'end',  
*p̃at̃* 'red bean', *sõt̃* 'pot', *kãt̃* 'outside', *kĩat̃* 'side'
- (8) *i*: 'Nominative', *i(ta)* 'Copula'  
*ɛ*: 'Accusative', *ilo* 'Directional/Instrument', *in* 'Topic'  
*ij* 'Genitive'<sup>5</sup>  
*ɛ*: *ɛ*- 'Locative/Dative/Goal'

- (9) 엄마, 술이[소시] 너무 무거워요.  
 1 2 3 4  
*amma*, *sõt̃-i* [sõsi] *namu* *mukawa-jo*  
 mom pot-NOM too heavy-DECLAR.ENDING

The frequency counts for the 112 noun + suffix combinations are obtained from the KAIST Concordance program (KCPMSTAT) containing 13.6 million words (<http://morph.kaist.ac.kr/kep/>). The corpus is based mainly on written texts (99 percent), but in casual speech of Korean, nominative and accusative suffixes are frequently omitted.<sup>6</sup> According to Cho (1981), cited in Y. Kim (1992), the nominative suffix is dropped around forty percent of the time and the accusative suffix is dropped close to ninety percent of the time in mothers' speech to young children. Based on these figures, the counts for nominative and accusative forms are adjusted to sixty percent

judgments. But, the bias, if any, should apply equally to low- and high-frequency words and should not affect the main outcome of the study.

<sup>5</sup> The genitive suffix, *ij*, is rarely, if ever, used in casual speech and even in read speech, it is pronounced as [ɛ] (H. Kang 1999). The data on genitive forms were also gathered but are not discussed in this paper.

<sup>6</sup> Without overt suffixes, the nouns are pronounced just as their isolation forms, with coda neutralization of final coronal obstruents.

and ten percent of the counts from the corpus in the following analysis. Words were divided into two frequency groups (low and high) with sixty-seven as a cutoff, the mean average of occurrences for the 112 words in the corpus after adjustment in nominative and accusative forms.

## 7. Results

Overall, high-frequency words show lower ratings for the innovative [s]-final pronunciation than low-frequency words: 3.36 (low-frequency words) vs. 2.61 (high-frequency words). The results support the claim that the change to [s] in Korean nouns is analogically motivated, given the cross-linguistic observation that analogical changes affect low-frequency words before high-frequency words.

When different final consonant and vowel contexts are examined separately, an interesting pattern emerges. If the resulting change happens to be phonetically unnatural, a statistically significant frequency effect is observed, but if the resulting change is phonetically natural, an [s]-final pronunciation gets high ratings across the frequency contexts and no statistically significant frequency effect is observed. In other words, even though the change to [s] as a whole is primarily motivated by a reason that has little to do with phonetic naturalness, the factor of phonetic naturalness emerges during the course of the propagation of the sound change. Now, I will discuss the three consonantal contexts separately, in detail.

With respect to /s̄/-final nouns, we find a statistically significant frequency effect in the expected direction: high-frequency words show far lower ratings for the innovative [s] pronunciation than low-frequency words.

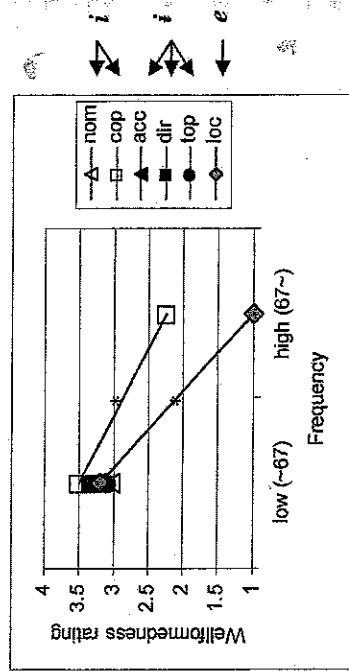


Figure 1. Mean ratings of [s]-final pronunciation for /s̄/-final nouns

Figure 1 shows the mean ratings of [s]-final pronunciations for originally /s̄/-final nouns in low- and high-frequency words. Ratings are presented

separately for different suffix contexts. The darkness of the shapes indicates the vowel quality of the suffixes (white *i*-, black *i*-, grey *e*-). All values are averages of the eight subjects. Figure 2 is a scatterplot of ratings of [s]-final pronunciation of these words against their frequency of occurrence in the KAJST corpus. The frequency counts in this figure are adjusted for nominative and accusative forms as explained above.<sup>7</sup>

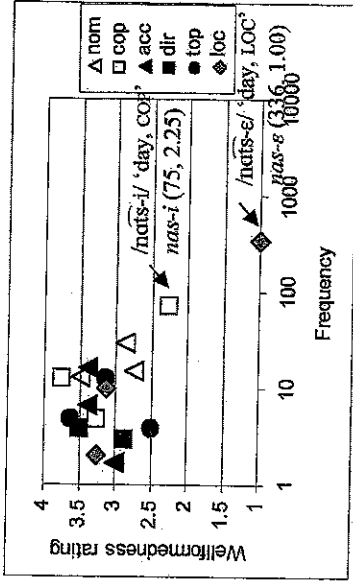


Figure 2. Scatterplot of ratings of [s]-final pronunciation for /s̄/-final nouns

In low-frequency words, vowel contexts do not make any difference in ratings: 3.23 (*i*) vs. 3.22 (*i*) vs. 3.19 (*e*). In high-frequency words, there is a sizable difference in ratings between different vowel contexts (2.25 (*i*) vs. 1.00 (*e*)), but the apparent vowel context effect seems to be a frequency effect in disguise, as the two data points representing 'day, COP' and 'day, LOC' in Figure 2 demonstrate. As for the phonetic context, given the fact that the plain affricate /s̄/ is realized as voiced in this position (cf. (3)), the change from a voiced affricate to a voiceless sibilant fricative is not a natural sound change from a phonetic point of view (Ko 1989).

With respect to /s̄<sup>h</sup>/-final nouns, the frequency effect is in the right direction—namely, overall high-frequency words show lower ratings for the innovative [s] pronunciation than low-frequency words—but the difference is not statistically significant. Figure 3 and Figure 4 show the mean ratings of [s]-final pronunciations for originally /s̄<sup>h</sup>/-final nouns.

<sup>7</sup>An analysis of the data without the frequency adjustments for the nominative and accusative forms produces largely the same outcome as that reported in the current paper, except that ratings of [s] pronunciations for accusative forms of /s̄/-final nouns show the frequency effect in the opposite direction. But, the difference is statistically insignificant: 3.19 (low) vs. 3.38 (high).

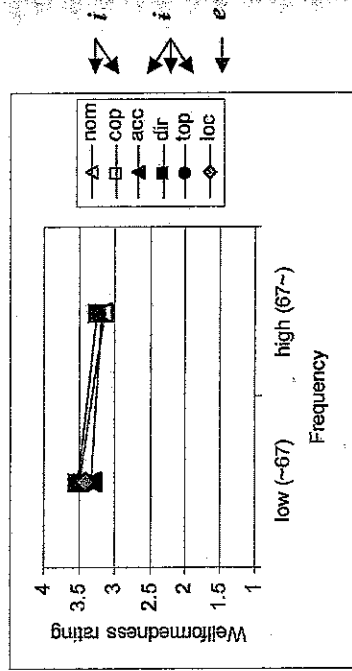


Figure 3. Mean ratings of [s]-final pronunciation for  $\bar{t}s̃$ -final nouns

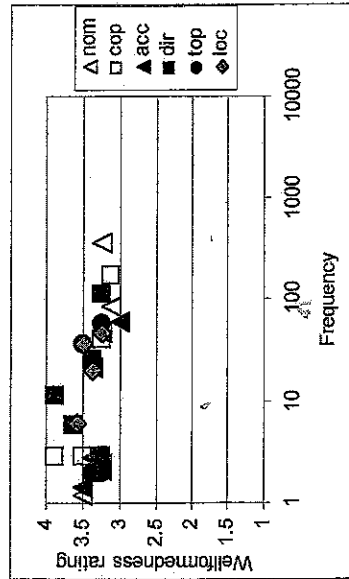


Figure 4. Scatterplot of ratings of [s]-final pronunciation for  $\bar{t}s̃$ -final nouns

Here again, the vowel context does not make any difference. Unlike the change from [d̃z] to [s], however, the change from [ts̃<sup>h</sup>] to [s] can be considered phonetically well-motivated as a type of lenition process (cf. Kirchner 1998, Lavoie 2000). I conjecture that the difference in phonetic naturalness is the reason for the different patterns of wellformedness ratings found in the two contexts. Since the change from [ts̃<sup>h</sup>] to [s] is phonetically natural, the change is expedited in this context relative to other phonetically less natural contexts, and we cannot observe a frequency effect that may have been there earlier in the course of the history due to a ceiling effect.

Finally, for /t<sup>h</sup>-final nouns, different patterns are found depending on the vowel context. Figure 5 and 6 show the mean ratings of [s]-final pronunciations for originally  $\bar{t}s̃$ -final nouns.

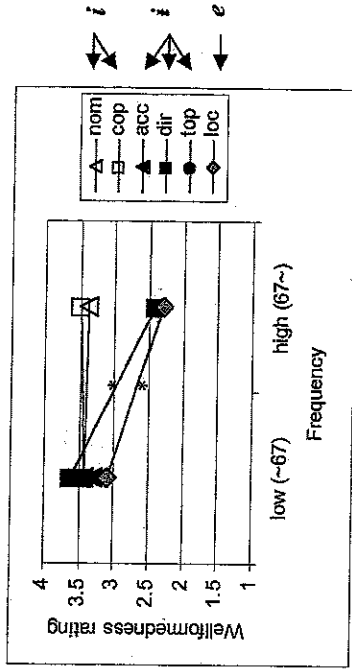


Figure 5. Mean ratings of [s]-final pronunciation for  $t̃$ -final nouns

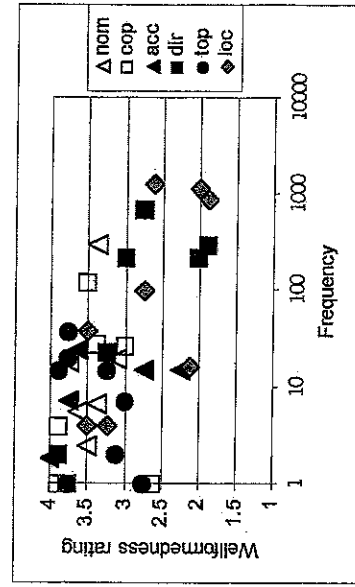


Figure 6. Scatterplot of ratings of [s]-final pronunciation for  $t̃$ -final nouns

When nouns are combined with /e/- or /i/-initial suffixes, a statistically significant frequency effect is observed as predicted. But, for forms with an /i/-initial suffix, the ratings are high across the frequency contexts and no frequency effect is observed.

Again, the difference can be explained by the difference in phonetic naturalness. Kirchner (1998) argues that a direct change of a coronal stop to a sibilant fricative ([t, t<sup>h</sup>] > [s]) is unnatural but that apparent cases of such sound change go through an intermediate affricate stage ([t, t<sup>h</sup>] > [ts, ts<sup>h</sup>] > [s]). This is exactly the case for the /t<sup>h</sup>-final nouns before /i/-initial suffixes. As mentioned in (2), there is a regular affrication process that affects these nouns only before /i/-initial suffixes. Since this is a long-established process, for the forms with /i/-initial suffixes, the change to [s] is not a direct change from [t<sup>h</sup>] but a change from [ts<sup>h</sup>] to [s], which is phonetically well-motivated. On the other hand, the [ts<sup>h</sup>] pronunciation is only marginally

available for these nouns before /ε/- or /i/-initial suffixes.<sup>8</sup> Therefore, the change involved is more likely a direct change from the stop to [s], which is not as phonetically well-motivated.

### 8. Conclusion

Overall, the change to [s] is more advanced in low-frequency words than in high-frequency words. In view of the cross-linguistic generalization that analogically motivated changes affect low-frequency words before high-frequency words, the current findings support the proposal that the change in Korean noun-final obstruents is analogically motivated. In those contexts where a frequency effect is not strong, it is conjectured that the change benefits from the natural phonetic conditioning and that the changes are expedited in such a way that any frequency effect that may have been there earlier is obliterated. Finally, the current analysis provides a natural explanation for the behavior of loanwords. Loanwords are initially adapted in isolation form in Korean (Kenstowicz & Sohn 2001), and inflected forms are derived from the isolation form. Since there is no preexisting inflected forms for loanwords—namely, the frequency is zero—the mapping (/V\_# → s/\_V) applies without resistance.

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<sup>8</sup> [s] pronunciations for /h/-final nouns before /ε, i/-initial suffixes show a frequency effect expected of analogical changes and also show a phonetic naturalness effect (/ε/ vs. /i/ context)

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