Phonetics versus phonology: English word final /s/ in Korean loanword phonology

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Abstract

In this paper we consider various perspectives on loanword phonology by examining the borrowing into Korean of English words having a word-final /s/. These have been borrowed into Korean with a tense [s] followed by an epenthetic vowel, as illustrated by the borrowing of English bus as [p̚esɪ]. The realization of English word-final /s/ as [s] is apparently unexpected given that English [s] and Korean plain (or lax) [s] seem to be quite similar. Moreover, English /s/ when part of a consonant cluster is consistently borrowed as lax [s] in Korean as exemplified by the borrowing of English test as [thesɪ]. Kim (1999) and Kim and Curtis (2002) claim that the borrowing of final /s/ as tense [s] versus its borrowing in a cluster as lax [s] is a case where subphonemic (nonprimary) acoustic properties in both languages are at issue, and thus are supportive of a perceptual matching approach to loanwords. According to them, the property at issue is consonantal duration. They show that English /s/ in a cluster has a shorter duration than /s/ alone and this correlates with the durational difference between tense [s] and lax [s] in Korean. Iverson and Lee (2004) agree with this view but take the length distinction between Korean tense and lax consonants to be phonemic rather than subphonemic. Here, we point out certain problematic aspects of the durational view of the borrowing of English /s/, and, then, offer a different account of the borrowing of English final /s/ as tense [s] by referencing phenomena internal to Korean phonology. While we do not deny the role of subphonemic and perceptual factors in how loanwords are realized, we suggest that a variety of factors, both phonetic and phonological, are involved in determining how a particular sound or sound sequence is realized in borrowing.

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1. Introduction

During the present decade loanword phonology has become a focus of study and a controversial issue within phonology. The issue of loanword phonology has become especially controversial with respect to its relation to the debate over the role of perceptual factors in phonology. One reason for the controversy is the development over the past 10 years of a finely articulated view of perceptual phonology, as especially witnessed in the works of Steriade (2001a,b), Flemming (1995, 2004), Jun (1995), Boersma (1998), among others. Under the P-map (i.e. Perceptual-map) hypothesis of phonology developed by Steriade and applied to loanwords in Kenstowicz (2003a, 2003b), loanword adaptation is seen as a problem of perceptually matching the words of one language into another, maintaining as much information from the source word while still satisfying the constraints of the recipient language. On this view, subphonemic variants should play an important role in how loanwords become adapted because borrowers try to maximize the perceptual similarity of the words from the source language in the recipient or borrowing language. Words are borrowed into the recipient language with the sounds that are most perceptually similar to those in the source language.

A contrary view is developed by LaCharité and Paradis (2002, 2005). Harking back to Haugen (1950), they emphasize the role of the bilingual in the borrowing process. Since the bilingual speaker has access to the phonology of both the source and recipient languages, borrowing is inherently phonological, with little or no role to subphonemic variants. LaCharité and Paradis (2002, 2005) give the example of the borrowing of English voiced stops into Spanish. They note that English voiced stops are perceptually more like Spanish voiceless ones in that both have similar VOT values. (Spanish voiced stops are fully voiced unlike English ones.) Moreover, they note that perceptual studies show that monolingual Spanish speakers confuse English voiced stops with voiceless ones. A P-map view would seem to hold that English voiced stops should be borrowed into Spanish as voiceless ones given the perceptual similarity between the two, but this does not happen. English voiced stops are consistently borrowed as voiced in Spanish. Consequently, according to LaCharité and Paradis the borrowing is phonemic. The bilingual borrowers have access to the phonologies of both languages and the low level acoustic differences between English and Spanish voiced stops are irrelevant in the borrowing process.

A third view is developed by Iverson and Lee (2004) who propose a principle of phonological perception which maintains that, in loanwords, phonetic representations from the source language are interpreted according to the salient perceptual categories of the recipient language. In a sense, this can be seen as a middle position between the P-map view of Steriade and the purely phonological view of LaCharité and Paradis. As an example, consider the difference in borrowing of French nasal final words between English and Korean. While French femme ‘woman’ is borrowed into English as [fɛm], it is borrowed into Korean as [pʰanm̚] with an inserted vowel after the final nasal. On the other hand, when English nasal final words are borrowed into Korean they never have a vowel after the nasal. For example, English time is borrowed as [tʰaim]. Kang, H (2002, 2003) explains the difference as due to the fact that final nasals are released in French but not in English. While final-nasal release is a subphonemic feature in both French and English, in Korean it is a perceptually salient feature distinguishing coda consonants which are never released from onset consonants. That is, any consonant with a release is interpreted by Korean speakers as an onset regardless of its syllable position in the source language. Consequently, the French word-final nasals are perceived as onsets by Korean speakers and thus require the presence of a following vowel. This contrasts with how French
nasal-final words are borrowed into English. These are borrowed as nasal-final, illustrated by the borrowing of *femme* ‘woman’ into English as *[fɛm]*. Consonant release is a subphonemic feature that is not perceptually salient in English, so English speakers are unaware of the difference between the French final nasals and the English final nasals, borrowing the French nasals as if they were unreleased. On Iverson and Lee’s (2004) view, then, one would not expect a subphonemic feature that is nonsalient in the recipient language to play a role in borrowing; the fact that French word-final nasal consonants are released is irrelevant in how they are borrowed into English since final consonant release is not a perceptually salient feature.

In this paper we consider the different perspectives on loanword phonology by examining the borrowing into Korean of English words having a word-final */s/*. These have been borrowed into Korean with a tense *[s]* followed by an epenthetic vowel, as illustrated by the borrowing of English *bus* as *[pʰɒsʌ]*. The realization of English word-final */s/* as *[s]* is apparently unexpected given that English *[s]* and Korean plain (or lax) *[s]* seem to be quite similar. Moreover, English */s/* when part of a consonant cluster is consistently borrowed as lax *[s]* in Korean as exemplified by the borrowing of English *stop* as *[sʰɒp]*. The inconsistent borrowing of English */s/* into Korean is also unexpected on the phonological borrowing account of LaCharité and Paradis (2002, 2005) where phonologically English */s/* should match up with Korean lax */s/*. Kim and Curtis (2002) specifically note the problem for such a phonological account. Instead, Kim and Curtis claim that the borrowing of final */s/* as tense *[s]* is a case where subphonemic (nonprimary) acoustic properties in both languages are at issue, and thus are supportive of a perceptual matching approach to loanwords. According to them, the property at issue is consonantal duration. They show that English */s/* in a cluster has a shorter duration than */s/* alone and this correlates with the durational difference between tense *[s]* and lax *[s]* in Korean. Iverson and Lee (2004) agree with this view but take the length distinction between Korean tense and lax consonants to be phonemic rather than subphonemic. Here, in this paper, we offer a different account of the borrowing of English final */s/* as tense *[s]* by referencing phenomena internal to Korean phonology rather than this being a case of perceptual mapping whether involving subphonemic features or perceptually salient ones. In section 2 of this paper we provide some background on Korean phonology that will be of relevance for our discussion. In section 3 we present the views of Kim and Curtis (2002) and Iverson and Lee (2004) that reference the subphonemic durational difference in English */s/* in different contexts as the key in determining whether English */s/* is borrowed into Korean as tense or lax. We point to certain problematic observations for such a view. In section 4 we offer our own analysis of the data, showing the important role of Korean internal phonology for understanding the realization of English final */s/* as tense *[s]*. In section 5 we extend our discussion to the borrowings of English words such as *test* that end in s-plus-stop clusters. In such words the */s/* is borrowed as plain *[s]* while the final */t/* is borrowed as aspirated *[tʰ]*. While the P-map hypothesis helps to explain partially the borrowing, we point to the role that nonperceptual factors play in loanword phonology. We conclude that the different perspectives on loanword phonology are not necessarily incompatible with one another. Rather, they can be used to explain different aspects of loanword phonology, even when it comes to the borrowing of a single sound or sequence as in the case of English */s/* in Korean.

2. Background on Korean phonology

The Korean consonant and vowel phoneme inventories are given in (1) (Sohn, 1999; Kang, Y, 2003; Lee, 1993)
The consonant inventory in (1) shows the well-known three-way laryngeal contrast in stops between the lax or plain stops, aspirated stops and tense stops. A common view of this three-way division from Kim (1970) is to consider the aspirated and tense series as laryngeally marked, the former for the feature [spread glottis] and the latter for the feature [constricted glottis]. The lax consonants would be laryngeally unmarked phonemes. While there has been much recent discussion on the precise nature of the underlying features for this three way division of stop consonants (e.g. Avery and Ildsardi, 2001; Duanmu and Kim, 2004; Ahn and Iverson, 2004 for different proposals) we will continue to use the traditional features of [spread glottis] and [constricted glottis] since we view aspirated and tense consonants as being laryngeally marked.

With respect to the salient acoustic cues that distinguish the three-way stop series, studies such as Choi (2002), Jun (1993), and Han and Weitzman (1970), among others, show that the relevant cues involve Voice Onset Time and pitch. Compared to English, Korean aspirated stops are heavily aspirated with a VOT often over 100 ms (Choi, 2002) while lax consonants are somewhat aspirated and tense consonants are unaspirated. It is important to note that while there is only a two way contrast in the strident fricative between lax /s/ and tense /s/, phonetic studies such as Kagaya (1974), Iverson (1983), and Cho et al. (2002) point to a breathy or aspirated quality of Korean lax /s/. This is not surprising in light of Vaux’s (1998) cross-linguistic finding that in their unmarked state voiceless fricatives are [+spread glottis]. With respect to pitch, both tense consonants and aspirated consonants leave a higher pitch on a following vowel as compared to lax consonants. Kang and Kang (2004) show that this is perceptually salient in the distinction between tense [s] and lax [s], especially in initial position.

The Korean syllable template is provided in (2a) with some additional observations in (2b) and (2c) (Lee, 1993).

(1) Korean Syllable Template

<table>
<thead>
<tr>
<th>Korean consonants</th>
<th>Korean vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>p t c k</td>
<td>i e o</td>
</tr>
<tr>
<td>ph th ch kh</td>
<td>e a</td>
</tr>
<tr>
<td>p’ t’ c’ k’</td>
<td>æ a</td>
</tr>
<tr>
<td>s h s’</td>
<td></td>
</tr>
<tr>
<td>m n η l</td>
<td>y w</td>
</tr>
</tbody>
</table>

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The Korean syllable template is provided in (2a) with some additional observations in (2b) and (2c) (Lee, 1993).
coda position since these are inherently released. The Korean lax stops are always fully voiced between vowels, or, more generally, between sonorants of any type. Finally, Korean strictly obeys the syllable contact law (Vennemann, 1988; Davis and Shin, 1999), thus, when a coda and a following onset are adjacent over a syllable boundary there cannot be a sonority rise. These syllable related characteristics as well as the three way distinction in laryngeal types among Korean obstruents discussed above will be important in the understanding and analysis of how English loanwords ending in /s/ are adapted into Korean.

3. The durational analysis of English /s/ final loanwords in Korean


(3) English words borrowed into Korean Korean realization of the English /s/ phoneme

| a. gas, bus, mass, peace, juice, DOS       | s'  |
| b. solo, single, ceramic                  | s'  |
| c. test, toast, post, disc, mask          | s   |
| d. stop, smog, snack, spar, skate         | s   |

(4) Examples

a. English ‘gas’ is borrowed as [kɛsɪ]  
b. English ‘bus’ is borrowed as [pʊsɪ]  
c. English ‘mass’ is borrowed as [mæsɪ]  
d. English ‘solo’ is borrowed as [sɒllo]  
e. English ‘test’ is borrowed as [tɛsɪ]  
f. English ‘stop’ is borrowed as [stɪ]  

As seen in (3a) and exemplified in (4a–c), English words that end in a single /s/ are borrowed into Korean with tense [s'] followed by the vowel [ɪ]. But an English /s/ that starts a word-final cluster is borrowed as plain [s] as in (3c) and exemplified in (4e). The behavior at the end of the word seems to mimic what is found at the beginning of a word where an /s/ in an initial consonant cluster in an English word is borrowed as [s] in Korean (3d, 4f) while a single word-initial /s/ gets borrowed as [s'] (3b, 4d). The question that arises is why the English source phoneme /s/ should be split into two in Korean, as the phoneme /s/ for words like in (3a) and (3b) and as /s/ for (3c) and (3d). This is particularly problematic for a view like that of LaCharité and Paradis (2002, 2005) where phonemic borrowing would expect a consistent matching of English /s/ as Korean /s/ (or perhaps as /s/, but not both).

Kim (1999) and Kim and Curtis (2002) take up the issue of the borrowing of English /s/ into Korean. They reviewed studies such as Kagaya (1974) that agree with the more recent work of Kang and Kang (2004) that the perceptually salient primary cue for distinguishing Korean /s/ from /s/ is the pitch on the following vowel, with high pitch cueing tense /s/. Kim and Curtis (2002) point out that such cues on a post-fricative vowel are not available in English and this is especially so when /s/ is word-final. Kim and Curtis then note a subphonemic secondary cue in
the English forms, namely, that of fricative duration. They point out that word-initial /s/ is longer when it is not part of an initial consonant cluster. Similarly, English /s/ at the end of a word is longer when it is not part of a word-final consonant cluster. Specifically, Kim (1999:32) found a 37 ms difference between English [s] when alone at the beginning of the word and initial English [s] in a consonant cluster at the beginning of the word. An even greater difference was found between a single final /s/ like in (3a) compared to the /s/ at the beginning of a word-final cluster like (3c). This length difference between a single /s/ and an /s/ in a cluster is clearly subphonemic in English since speakers are not aware of any such difference. Kim and Curtis (2002) then note that in Korean there is a phonetic difference in length between /s/ an /s/ with the latter being longer in duration. They also do not view this length difference as being the primary salient cue that distinguishes the two Korean phonemes; rather experimental studies point to the pitch difference on the vowel following the fricative phonemes as being the primary cue distinguishing /s/ from /s/. Consequently, Kim (1999) and Kim and Curtis (2002) conclude that it is a nonprimary feature of length (i.e. subphonemic in both English and Korean) that determines whether English /s/ is borrowed into Korean as the somewhat longer tense [s] (3a, 3b) or the somewhat shorter plain [s] in (3c, 3d). If this is correct, it would constitute a strong case of subphonemic variants being important in loanword adaptation given the claim that the length on strident fricatives is a nonprimary feature in both languages. Consequently, it would be a case of loanword adaption that is consistent with the P-map hypothesis of Steriade (2001a,b) over against the phoneme-borrowing hypothesis of LaCharité and Paradis (2002, 2005).

A somewhat different interpretation of the fricative duration data of Kim (1999) is put forward by Ahn and Iverson (2004) and Iverson and Lee (2004). These authors take a view reflected by Korean orthography and argued for by Han (1992, 1996) and Ko (1998) that duration is the primary cue (not the secondary one) differentiating tense obstruents from their lax counterparts. That is, the Korean tense consonants are phonologically geminates. (For arguments against the view of tense consonants as phonological geminates see Cho and Inkelas (1994), Tak and Davis (1994), and Tak (1997.).) Ahn and Iverson (2004) specifically argue that the feature [constricted glottis] is an enhancement feature on the Korean tense (i.e. geminate) consonants, not part of the underlying representation. In their view, tense consonants are unspecified underlyingly for laryngeal features (but are so specified on the surface), but have a geminate representation of a single phoneme linked to two C-slots underlyingly. As a consequence, Ahn and Iverson (2004) and Iverson and Lee (2004) contend that the borrowing of English /s/ as reflected in (3) is striking confirmation for a phonological conclusion that Korean speakers are phonemically sensitive to differences in consonantal duration. English /s/ when not part of a cluster as in (3a, 3b) is borrowed as tense since it is perceived as a geminate given its longer duration. Iverson and Lee (2004) thus maintain that the borrowing pattern is supportive of their principle of phonological perception which maintains that, in loanwords, phonetic representations from the source language (English duration) are interpreted according to the salient perceptual categories of the recipient language (phonemic consonantal length on the fricative in Korean).

While the durational difference in English /s/ depending on whether it is in a cluster or alone is a real one, it is not clear whether it is the key factor in determining the outcome of English /s/ when borrowed into Korean. We point to a number of problematic aspects to the durational view. First, as Kim (1999) and Kim and Curtis (2002) note, duration would have to be relative to position (i.e. beginning of word or end of word) because a single word-final /s/ as in bus does not differ significantly in duration from a word-initial /s/ in a consonant cluster, as in stop. Second, as mentioned in section 2, several recent studies such as Choi (2002) show that high pitch on a
following vowel is a salient cue for distinguishing a tense consonant from its lax counterpart. The experiments of Kang and Kang (2004) show that this is even more important than length with respect to the strident fricative (at least in word-initial position). In experiments with native Korean speakers as subjects and using synthesized tokens, the Korean speakers perceived the English /s/ of sale as tense. Kang and Kang then placed English /s/ from the word sale in front of forms beginning with ‘CV’ (e.g. mile to make smile); in such a context the Korean speakers perceived the /s/ originally from sale as being lax rather than tense. The explanation given was that since the /s/ was no longer immediately followed by a high pitch (stressed) vowel it was not perceived as tense, thus implying that length is not the key factor in the perception of English /s/ as tense or lax. A further problem that Kim and Curtis (2002:417) themselves note for their duration-based analysis involves the borrowing of English words in which a consonant precedes a word-final /s/. Words like dance and false are borrowed into Korean with the tense /ʃ/, [tʰænsʰ] and [pʰolsʰ], respectively, even though the /s/ is of shorter duration in the cluster. Finally, the English voiceless interdental fricative, /θ/, is consistently borrowed into Korean as tense /s/ regardless of its position (Ahn, 2003) and despite the fact that it is of shorter duration than English /s/ (Miller and Nicely, 1955). All this taken together suggests that the length of /s/ may not be the relevant factor in determining whether English /s/ is borrowed into Korean as tense or lax.

4. A laryngeal-based analysis of English /s/ final loanwords in Korean

In this section we put forward a novel solution to the borrowing of English word-final /s/ as tense. We not only include examples like that in (3a) but also a word-final /s/ in a cluster. Relevant examples are given in (5).

(5) Borrowing of word-final /s/ as tense [sʰ] in Korean

a. English ‘gas’ is borrowed as [kʰesʰ]
b. English ‘bus’ is borrowed as [pʰɔsʰ]
c. English ‘mass’ is borrowed as [mæsʰ]
d. English ‘dance’ is borrowed as [tʰænsʰ]
e. English ‘false’ is borrowed as [pʰolsʰ]

Our proposal is that word-final /s/ as in (5) is borrowed into Korean as tense [sʰ] because it is in a position where it should be aspirated. But since the aspirated coronal strident /sʰ/ is not a phoneme of Korean, the word-final English /s/ gets borrowed with the other marked laryngeal feature [constricted glottis] and so surfaces as tense [sʰ]. A salient observation about Korean phonology is that /s/ surfaces as tense in positions where voiceless stops must surface as aspirated. After providing data that supports this observation, we show that English word-final (released) voiceless obstruents (other than the coronal fricatives) are always borrowed as aspirated in Korean. Since the (voiceless) coronal fricative in this position cannot be phonemically aspirated, it is borrowed with the other marked laryngeal feature surfacing as tense. Thus, the process of adding the laryngeal feature reflects the native phonological system. One advantage of this proposal is that it explains why English final /s/ is borrowed as tense whether it has longer duration as in (5a–c) or shorter duration as in (5d–e).

The evidence internal to Korean phonology that Korean /s/ becomes [s] in environments where it should be phonologically aspirated comes from the phenomenon of /h/ merger with a following stop, traditionally referred to as progressive aspiration. (See, for example, Kim-Renaud, 2002:417).
(1986) for a rule-based analysis, Kim (1987) and Tak (1997) for feature-geometric analyses, and Davis and Cho (2003) for an optimality-theoretic analysis.) Data are provided in (6), though here we do not distinguish between morpheme boundaries of different types.

(6) Korean h-merger before a following stop

<table>
<thead>
<tr>
<th>Underlying Forms</th>
<th>Phonetic Forms</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /coh + ko/</td>
<td>[co.kʰo]</td>
<td>‘like (and)’</td>
</tr>
<tr>
<td>b. /nah + ta/</td>
<td>[na.tʰa]</td>
<td>‘give birth’</td>
</tr>
<tr>
<td>c. /nolah + ta/</td>
<td>[no.ra.tʰa]</td>
<td>‘is yellow’</td>
</tr>
<tr>
<td>d. /coh + ta/</td>
<td>[co.tʰa]</td>
<td>‘like (declarative)’</td>
</tr>
</tbody>
</table>

As seen in (6), when /h/ precedes a lax stop, the /h/ deletes while the stop becomes aspirated. Notice that tensification of the stop following /h/ does not occur. Korean has a well-known process of post-obstruent tensification (Kim-Renaud, 1986; Cho and Inkelas, 1994). The post-obstruent tensification rule from Kim-Renaud (1986) is given in (7a) with exemplification in (7b) and (7c).

(7) Post-obstruent tensification (Kim-Renaud, 1986)

<table>
<thead>
<tr>
<th>C [-----] [+constricted glottis] / C [-----] [-sonorant]</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. /cap-ta/ -- [capt'a] ‘to catch’</td>
</tr>
<tr>
<td>c. /nopʰ-ta/ -- [nop'ta] ‘high (declarative)’</td>
</tr>
</tbody>
</table>

Post-obstruent tensification takes a plain obstruent and tensifies it when it occurs after another obstruent. As the examples in (7b) and (7c) show, the triggering obstruent can either be a plain one or an aspirated one. Thus, if one compares (7c) with (6b) we see that an aspirated consonant triggers tensification but the laryngeal phoneme /h/ triggers aspiration. The data in (6) show aspiration even though the environment for tensification seems to be met; this is especially so if we keep in mind that coda /h/ can neutralize to [t] (Kim-Renaud, 1986; Ahn and Iverson, 2004), so possible outputs for (6b) such as *[nat'a] or [nat'a] are realistic possibilities. One can either derive the difference between (6b) and (7c) on a rule ordering analysis (Kim-Renaud, 1986) or an optimality-theoretic analysis (Davis and Cho, 2003). While we do not pursue the details of an analysis here, the important point for our discussion emerging from (6) and (7) is that a voiceless obstruent (stop) following the phoneme /h/ surfaces as aspirated, not as tense.

Now let us consider the data in (8) where a morpheme-final /h/ occurs before /s/. Here, it seems that the phoneme /h/ triggers tensification of the following /s/ before deleting.

(8) Korean h-merger before /s/

<table>
<thead>
<tr>
<th>Underlying Forms</th>
<th>Phonetic Forms</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /coh + so/</td>
<td>[co.s'o]</td>
<td>‘good idea’ (I like it)</td>
</tr>
<tr>
<td>b. /noh + so/</td>
<td>[no.s'o]</td>
<td>‘put it’</td>
</tr>
<tr>
<td>c. /ha + so/</td>
<td>[ha.so]</td>
<td>‘do’</td>
</tr>
</tbody>
</table>

In comparing (8) with (6), we see that /s/ is realized as [s'] in environments where voiceless stops are realized as aspirated. Specifically, the voiceless stops are aspirated after /h/ in (6), while /s/
becomes tense after /h/ in (8). This suggests that when /s/ is required to take on phonologically a laryngeal feature it will be tense (i.e. [constricted glottis]). The cases in (8) are different from post-obstruent tensing in (7) in that the phonetic motivation that may exist for tensification in (7) is absent in (8) when /h/ deletes. (That is, the consonant that triggers tensification is not surface apparent in (8).) Moreover, if one keeps in mind that Korean lax [s] phonetically has a breathy or aspirated quality, as noted in section 2, one might expect that underlying forms in (8) should result in phonetic forms having /h/ deletion without tensification of /s/ so as to preserve the breathy quality of the /h/ in a way similar to (6). The data in (8) suggest that the articulatory fact that Korean /s/ is breathy or made with [spread glottis] is irrelevant to the phonology. Instead, we understand the tensification of /s/ in (8) as not being phonetically motivated. Rather, as shown in (6), voiceless obstruents after /h/ in Korean are able to preserve the laryngeal feature of the consonant /h/ which is a target for deletion when in noninitial position. (See Kim-Renaud (1986), Lee (1998), Davis and Cho (2003) regarding Korean h-deletion.) The Laryngeal Node of the /h/ with the [spread glottis] feature is preserved on the stop. This is shown autosegmentally by the delinking and spreading processes in (9). (See Kim (1987) and Tak (1997) for a similar analysis.)

(9) Autosegmental representation of /h/-merger with a following stop (↓ indicates delinking)

```
   C  C
   ↓  ↓
  h  stop
  ↓  /  ↓
  /  /  ↓
Lar  Place
  ↓
  [s.g.]
```

Our claim is that the same process occurs for the data in (8), as illustrated in (10), with the resulting coronal fricative preserving the laryngeal node from the /h/, but surfacing with the other marked laryngeal feature [constricted glottis] and so is realized as tense [s']. One can view this as a repair strategy given that Korean does not have the phoneme aspirated /sʰ/.

(10) Autosegmental representation of /h/-merger with a following /s/

```
   C  C
   ↓  ↓
  h  s
  ↓  /  ↓
  /  /  ↓
Lar  Place
  ↓
  [s.g.]  ( --→ [c.g.] as a repair strategy)
```

Essentially, the same process of rightward laryngeal node spreading from /h/ (shown in 9 and 10) applies to all obstruents whether fricatives as in (8) or stops as in (6). The only difference is that where the voiceless stops surface as aspirated in (6) the /s/ surfaces as tense as in (8). That is, since Korean does not have phonemically aspirated fricatives, the /s/ in (8) surfaces
with the other marked laryngeal feature, [constricted glottis], and thus is phonetically a tense consonant.

Given this as background, let us now consider English loanwords in Korean with word-final voiceless stops. Here, we only consider borrowed words that are interpreted as having a release and so would be the onset of the syllable. It is well known that English words ending in a stop consonant when borrowed into Korean show variable behavior. Some words are borrowed with a released stop, such as coke, [kʰokʰi], others with an unreleased stop, such as kick [kʰik], and still others as either released or unreleased, such as tape [tʰeipʰi] or [tʰeip]. Kang, Y (2003) offers an interesting interpretation for the separate problem of why some English word-final stops are interpreted as being released (and so are syllable onsets in Korean) and others unreleased (and are codas in Korean). Since borrowed words with unreleased final stops are not relevant for our discussion, we only consider words that are borrowed with a final released consonant. (According to Kang, Y (2003) a release of a final stop in English borrowed words is more likely to occur if the English stop is voiced, coronal, after a tense vowel, or in a monosyllabic word, but none of these factors is categorical.) As seen by the representative examples in (11), English borrowings with word-final released voiceless stops are borrowed into Korean as aspirated even though such consonants are not typically aspirated (even if released) in English. (See the appendix of Kang, Y (2003) for many more examples. Also, see Johnson (1997) for the acoustic distinction between word-final release and aspiration.)

(11) Borrowings with final voiceless stops are interpreted as aspirated if released
   a. English ‘coke’ is borrowed as [kʰokʰi]
   b. English ‘rope’ is borrowed as [ropʰi],
   c. English ‘tape’ is borrowed as [tʰeipʰi] (or [tʰeip])

One can ask why the released voiceless consonant is required to be aspirated as opposed to tense or even lax. That is, in a borrowing like rope as [ropʰi], why can’t the final labial stop be tense or lax instead of aspirated given that the stop is not normally aspirated in English? From a Korean-specific perspective, either the tense or lax consonant would be a worse perceptual match with the English final stop than an aspirated consonant. The English final voiceless stop in the borrowings in (11) cannot be realized as a tense stop given the discussion earlier of the correlation between tense stops and high pitch (or stress) on vowels. It has been observed (Hyunsook Kang, personal communication) that the tense consonants that occur in English loanwords in Korean are most often immediately before a stressed vowel, indicating that the high pitch of a stress vowel is what induces tensification of the stop. The final stops in (11) are not before a stressed vowel, nor, for that matter, are they in the environment to undergo post-obstruent tensification; thus they do not surface in Korean as tense. The English final voiceless stops also cannot be realized as a lax stop, because in the Korean borrowings of the words shown in (11), the English final stop is interpreted as intervocalic in Korean and so would have to be fully voiced as mentioned in (2c). This would be a perceptual mismatch with the English voiceless stop which is not fully voiced. (Note that English word-final voiced obstruents that are interpreted as released are borrowed into Korean with a lax stop followed by a vowel; for example, code is borrowed as /kʰotʰi/, with the /t/ pronounced fully voiced preserving the original voicing quality.) Consequently, one can view the borrowing of the English final voiceless stops as aspirated stops in data like that in (11) because they are the least worst given the alternatives. That is, even though the Korean aspirated stops are not a good match for the
English final released (unaspirated) stops, the other alternatives (tense or lax stops) are worse. We note, then, that both phonetic (perceptual) and phonological factors are involved in the realization of the English final voiceless stops as aspirated.

We see from the above discussion that English word-final voiceless stops when borrowed into Korean are required to have the laryngeal feature of [spread glottis]. Now reconsider the data in (5a)–(5c) repeated in (12) of English loanwords ending in a single /s/. Since fricatives are necessarily released, we see that English words ending in /s/ are borrowed into Korean with the /s/ being interpreted as an onset to a syllable with a vowel, [i].

(12) Borrowsings with a single word-final /s/

a. English ‘gas’ is borrowed as [kɛʃi]

b. English ‘bus’ is borrowed as [pɔʃi]

c. English ‘mass’ is borrowed as [mæʃi]

We contend that English words like in (12) with a word-final voiceless coronal fricative are borrowed into Korean with tense /s/ because they too, like the voiceless stops (in 11), must be phonologically realized with a laryngeal feature. Given that Korean does not have a phonemic aspirated /sh/, this can only be realized with the other laryngeal feature [constricted glottis]; so such words are borrowed into Korean with tense /s/. This is despite the fact that there is no high pitch on a following English vowel that would most naturally correlate with a tense consonant. Moreover, we argue that the duration of the word-final /s/ is not at issue, because the word-final /s/ in English is borrowed as tense whether it is single as in (12) or at the end of a consonant cluster as in (13).

(13) English borrowings with a final /s/ in a cluster

a. English ‘dance’ is borrowed as [tɛnsi]

b. English ‘false’ is borrowed as [pʰɔlʃi]

Kim and Curtis (2002) specifically note that such words are a problem for a durational view since the English /s/ is not of longer duration in this environment. We observe that the words in (13) parallel the forms in (14) where an English voiceless stop at the end of a word final cluster is also borrowed with a laryngeal feature, namely [spread glottis].

(14) English borrowings with a final voiceless stop in a cluster

a. English ‘lamp’ is borrowed as [ræmpʰi]

b. English ‘print’ is borrowed as [pʰrɪntʰi]

c. English ‘milk’ is borrowed as [milkh]

On our view, the data in (12) and (13) are like all word-final examples of borrowings with (released) voiceless consonants in requiring a laryngeal feature when borrowed into Korean; since /s/ cannot be aspirated in Korean, it is realized as tense in a way parallel to the aspiration of stops seen in the data in (11) and (14). The duration of the consonant is not at issue.

Further support for our analysis comes from the borrowing of two other English voiceless fricatives into Korean. Specifically, English words with word-final /f/ are borrowed into Korean...
with an aspirated /pʰ/ while the voiceless interdental fricative is borrowed as tense /s/. Examples are shown in (15).

(15) English borrowings with /f/ and /θ/

   a. English ‘half’ is borrowed as [hepʰɪ]
   b. English ‘tooth’ is borrowed as [tʰuʃɪ]
   c. English ‘month’ is borrowed as [mənsɪ]
   d. English ‘three’ is borrowed as [sʰiɾi]

First we note that English /f/ is borrowed as the aspirated stop [ph] in Korean and not as a fricative. This is because Korean only has labial stops. The labial stop surfaces as aspirated as would be expected of a borrowing with a word-final (released) voiceless stop. Then, what is of direct relevance is that the English voiceless interdental fricative, /θ/, is consistently borrowed into Korean as tense /s/ regardless of its position (Ahn, 2003) and despite the fact that it is of shorter duration than English /s/ (Miller and Nicely, 1955). Ahn (2003:991–992) specifically notes that the substitution of /k/ for English /θ/ occurs even though Korean /s/ is closer to English /θ/ in (lack of) tenseness and that it is problematic for length-based analyses like that of Kim (1999) and Kim and Curtis (2002) given the systematicity of English /θ/ being borrowed as [s] regardless of position in the word. On our view, we would account for the substitution of tense [s] for English /θ/ in examples like (15b) and (15c) since the voiceless fricative is in a position where other voiceless sounds surface with a laryngeal feature [spread glottis] as seen in (11), (14) and (15a). Because the Korean coronal strident cannot be phonemically aspirated (i.e. having the feature [spread glottis]), it surfaces as tense [s] possessing the other laryngeal feature [constricted glottis]. It is possible that the borrowing of /θ/ as [s] even in cluster-initial position as shown in (15d) may be due to similar reasons, or due to a tendency of uniform substitution for certain phonemes or sequences of phonemes regardless of position, as has been proposed by Kang (1996, 2002), and will be discussed in the next section. Nonetheless, forms like that in (15b–d) as well as that in (13) argue against a phonetic duration view of the borrowing of English /s/ as tense [s], and is supportive of our proposal that word-final English /s/ surfaces as tense in Korean since it is in a position where it needs to have a (phonemic) laryngeal feature.

5. The borrowing of English /s/-plus-stop clusters

In one sense we have maintained a largely phonological account of the borrowing of English word-final /s/ as tense /s/ in Korean. Essentially, English word-final /s/ when borrowed into Korean is realized as tense [s] since it is in a position where it requires a laryngeal feature. Given that Korean does not have a phonemic aspirated /sʰ/, it is borrowed as tense /s/. Duration is not at issue, be it subphonemic (Kim and Curtis, 2002) or phonemic (Iverson and Lee, 2004). That duration is not at issue is evidenced by the borrowing of words like ‘dance’ as [tʰænsɪ] where the English [s] is of shorter duration in the word-final post-consonantal environment. If we reject a length-based analysis of the borrowing of English /s/ into Korean then we need to address the issue as to why the /s/ in English s-plus-stop clusters as in (3c) and (3d) are borrowed as a lax [s] in Korean. Moreover, we need to ask why is the stop in s-plus-stop clusters aspirated when borrowed into Korean even though the English voiceless stop after /s/ is clearly not aspirated? In this section we will account for their borrowing by following Kang (1996, 2002), Oh (1996), and Davis and Kang (2003) by arguing that the s-plus-stop loanword data reflect what Kang has
termed a principle of uniform substitution. That is, there may be cases in loanword borrowing where identical sounds or sequences are consistently borrowed in an identical manner regardless of their position in a word.

Consider the data in (16) which show how English words with s-plus-stop sequences are borrowed into Korean.

(16) The borrowing of English sp, st, and sk into Korean

<table>
<thead>
<tr>
<th>English</th>
<th>Korean</th>
<th>English</th>
<th>Korean</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. sketch</td>
<td>[sʰtʰikʰi]ecʰi]</td>
<td>e. strike</td>
<td>[sʰtʰiɾaihkʰa] or [sʰtʰiɾaihkhʰa]</td>
</tr>
<tr>
<td>b. sponge</td>
<td>[sʰpʰonji]</td>
<td>f. stress</td>
<td>[stʰiɾesʰ]</td>
</tr>
<tr>
<td>c. stop</td>
<td>[sʰtʰopʰ]</td>
<td>g. piston</td>
<td>[pʰisʰtʰon]</td>
</tr>
<tr>
<td>d. stick</td>
<td>[sʰtʰikʰ]</td>
<td>h. test</td>
<td>[tʰesʰtʰa]</td>
</tr>
</tbody>
</table>

Four different environments are reflected by the data in (16). In (16a–d) the s-plus-stop sequence is word-initial before a vowel. In (16e–f) it is word-initial before a liquid (part of a triconsonantal cluster), in (16g) the s-plus-stop sequence is intervocalic word-medially, and in (16h) it is word-final. From a perceptual viewpoint all these four environments are quite different. This is clear if we focus on the stop consonant after /s/. In (16a–d) it is immediately before a stressed vowel. In (16e–f) it is sandwiched between two consonants, in (16g) it is before a stressless vowel, and in (16h) it is word-final. From a perceptual point of view one would expect different outcomes of the s-plus-stop sequences when borrowed into Korean. And, in fact, in some languages they do have different outcomes. For example, in Cantonese (Silverman, 1992), words like *post* with a final /st/ cluster in English are borrowed without the final /t/ whereas initial /st/ clusters have both consonants preserved in the Cantonese rendition. Oh (1996) and Kang (2002) have specifically noted that with respect to words like that in (16a–d) it is actually the tense stop that is the best approximation for the English unaspirated stop that occurs after the initial /s/. That is, according to them, a word like *stick* should be borrowed as [sʰtʰikʰ]. This most likely has to do with the significance of the correlation between tense consonants and high pitch on the following vowel. However, the tense stop would not be a good approximation for the borrowed English /t/ in the words in (16e–16h) since the borrowed /t/ from the /st/ cluster in these words does not occur before the stressed vowel. Consequently, we would maintain that the data in (16) can only be understood by the notion of uniform substitution, which is more supportive of a phonological view like that of LaCharité and Paradis (2002, 2005). Nonetheless, when we consider the details of the uniform substitution of the English voiceless stop in the s-plus-stop sequence certain outcomes are ruled out by perceptual factors. Specifically, the English voiceless stop after /s/ cannot be borrowed as a lax stop in Korean because the stop in an s-cluster is perceived as being intervocalic by Korean speakers. Since the lax stop would be intervocalic it would have to be fully voiced, as mentioned in (2c). The fully voiced stop would be a perceptual mismatch with the English voiceless unaspirated stop. In a sense, the stop in an English s-cluster is borrowed as aspirated in Korean because it is perceptually the least worst of the alternatives given uniform substitution. While some have offered plausible phonetic accounts as to why the English stop in an s-cluster is borrowed as aspirated based on word-initial clusters (e.g. Iverson and Lee, 2004), the phonetics of English word-final s-plus-stop clusters are quite different; yet, nonetheless, as seen by the data in (16), the clusters are always borrowed uniformly. The borrowing of in the initial /s/ in a cluster as lax [s] rather than tense [s] just reflects uniform substitution and may or may not be otherwise motivated.
6. Conclusion

In conclusion, the borrowing of English final /s/ into Korean does not support one particular view of loanword phonology. Different aspects of the borrowing are compatible with each of the three views presented in section 1. For example, the interpretation of English word-final /s/ in Korean as an onset is supportive of Iverson and Lee’s (2004) principle of phonological perception given that the nonsalient category of coda release in English is perceptually salient in Korean determining what is an onset and what is a coda. The P-Map hypothesis of Steriade (2001a,b) can help us understand why the stop after English /s/ is not borrowed as lax; given that such a stop would be intervocalic in Korean it would need to be fully voiced. This makes it a perceptual mismatch with the English voiceless unaspirated stop, even though [voice] is a subphonemic feature in Korean. On the other hand, phonological factors play a critical role both in terms of how sequences are borrowed and with respect to the language-specific realizations of certain phonemes. For example, the utter systematicity for how English s-plus-stop sequences are borrowed into Korean, regardless of their position in the word as seen in (16), is best understood by the notion of uniform substitution, which is more supportive of a phonological view like that of LaCharité and Paradis (2002, 2005) where borrowers have access to the phonology of both languages. Finally, as argued for in this paper, the specific realization of English final /s/ as tense [s] in Korean, whether at the end of a cluster like in (13) or alone like in (12), is best understood with respect to Korean phonology where Korean /s/ is realized as tense [s] when it is required to surface with a laryngeal feature. We speculate that when other specific cases of borrowing are examined in detail the same range of factors, both phonetic (including perceptual) and phonological, will play a role in determining how the sound or sequence is realized in the recipient language.

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