

# Varied adaptation patterns of English stops and fricatives in Korean loanwords:

## The influence of the P-map

Hanyong Park

Department of Linguistics, Indiana University

### Abstract

In order to investigate to what extent perceptual factors affect the borrowing process, we examined the borrowing of English obstruents in Korean by comparing loanword adaptation patterns with the natives' P-map (Steriade, 2001b). The orthographic classification technique was used to obtain the P-map (e.g., Wiik, 1965; Schmidt, 1996); 40 native Koreans were asked to choose the best matching Korean sounds with Korean orthography after listening to English nonsense words consisting of the vowel /a/ and 10 English labial and coronal consonants /p b f v t d s z θ ð/ in three prosodic locations such as word onset, pre- and post-stressed intervocalic positions (e.g., /pa/, /ápa/, /apá/). A comparison of the results with loanwords suggests that the P-map, in general, guides the borrowing process although there exist some mismatches between the P-map and the loanword adaptation patterns. Based on the perceptual results, two P-map constraints are proposed: *BeSimilar[voice]* and *BeSimilar[ConDur]*. Then, Korean loanwords of English obstruents are analyzed as the interaction between the perceptually motivated constraints and non-perceptual constraints, i.e., *Ident(place)* and *\*Cont*, under the Optimality Theoretical framework in order to capture the somewhat limited role of the P-map in loanword phonology.

### 1. Introduction

Recently, there has been an increasing interest in the study of loanword phonology. One reason for this is that the study of loanwords can provide much insight on phonological systems in general. Loanword phonology involves at least two phonological systems: one in the recipient language and the other in the source language. Many questions arise when two different phonological systems conflict with each other. Which one has more influence on loanword adaptation patterns, the source language or the recipient language? If the phonological systems of both languages are reflected, how does the sound adaptation process operate in order to resolve the conflict? Is the borrowing process operating at a phonemic level or at a sub-phonemic level? How can we explain the borrower's choice of adaptation of foreign sounds among many possible strategies within the phonological system of the recipient language? Why do borrowers sometimes display varied patterns in borrowing a single sound?

One benefit from the study of loanword phonology is that hidden language internal constraints in the borrowing language can be uncovered by a unique pattern of loanwords; thus, loanwords can be used as a window for looking at a phonological

system of the recipient language (Davis, 1993). For example, Kim & Curtis (2002) report that English /s/ in a cluster is always adapted as lax [s] in Korean, while English /s/ in a singleton is never adapted as lax [s] but as tense [s']. They observed that the absolute duration of the singleton [s] in English is always longer than [s] in the cluster both word-initially and word-finally. Their perception experiment with 16 native Korean listeners showed that Koreans were sensitive to the durational change of [s]. Thus, they claimed that Koreans' sensitivity to the consonant duration or the frication of /s/ results in different adaptation patterns for English /s/ in Korean. In other words, a constraint related to consonant duration exists in Korean phonology although this constraint is not very apparent; it emerges only when a foreign input comes into Korean.

Another question of interest that arises when two phonological systems come into conflict with each other is the role of perception in phonology. The role of perception cannot be overlooked in loanword phonology since there is ample evidence for perceptual difficulties in the identification of foreign sounds in cross-language speech perception and second language acquisition. Some research includes Best, McRoberts, & Goodell (2001) on the perception of Zulu by American listeners, Han (2002) on /r-/l/ perception by Korean listeners, Ingram & Park (1998) on /r-/l/ perception by Japanese and Korean listeners, Logan, Lively, & Pisoni (1991) on /r-/l/ perception by Japanese listeners, Singh & Black (1966) on cross-language perception of 26 intervocalic consonants (Hindi, English, Arabic, and Japanese), and Van Wijngaarden, Steeneken, & Houtgast (2002) on the perception of English and German by Dutch listeners. Moreover, the role of perception in loanword phonology has been emphasized in the works of theoretically oriented phonologists such as Flemming (2004), Kang (2003), Kenstowicz (2003a,b, 2005, 2006), Kim & Curtis (2002), Peperkamp & Dupoux (2003), Silverman (1992), Steriade (2001a,b), Takagi & Mann (1994), and Yip (1993). Although their claims on the role of perception in loanword phonology differ somewhat from one another in the details, the main idea underlying these authors' works can be well summarized by the P-map (i.e. Perceptual-map) hypothesis developed by Steriade (2001b). Under the P-map account, a sound in the source language is adapted into the recipient language in a way that maximizes the similarity between the two sounds (i.e. the sound in the source language and the adapted sound in the recipient language), but without violating the phonotactics of the recipient language. A consequence of the P-map is that even sub-phonemic properties may play a crucial role in the borrowing process if the sub-phonemic properties enhance the similarity of the sounds.

Contrary to the perceptual approach, the works of LaCharité & Paradis (2002, 2003) emphasize the role of bilinguals in the borrowing process. According to this view, bilinguals have complete access to both the source and recipient language phonologies in the borrowing process; thus, sub-phonemic information is irrelevant and only phonemic or featural level matching between the sounds play an important role in loanword adaptation. For example, English high lax vowels /ɪ/ and /ʊ/ are systematically adopted as Mexican Spanish /i/ and /u/, respectively. However, Mexican Spanish /e/ and /o/ are acoustically closer to English /ɪ/ and /ʊ/ than Mexican Spanish /i/ and /u/ are. Therefore, LaCharité & Paradis argue that the adaptation of English high lax vowels in Mexican Spanish is not affected by perceptual factors but is the phonemic category matching of the feature [+high].

Iverson & Lee (2004) take a middle position between these two opposing views (Davis & Cho, 2006). They propose a principle of phonological perception, which claims that sub-phonemic information in the source language is relevant in loanword adaptation only when it is salient in the recipient language. Kim & Curtis (2002) argue that consonant duration, which, according to them, is a sub-phonemic property in both English and Korean, plays an important role in varied adaptation patterns of English /s/ in Korean. However, according to Iverson & Lee's view, the varied adaptation patterns of English /s/ in Korean confirms that consonant duration is not a secondary cue in Korean as Kim & Curtis (2002) claim, but the primary or salient cue among native Koreans.

In this paper, we examine Korean loanwords borrowed from English. We especially focus on varied adaptation patterns of English stops and fricatives in Korean. Some English obstruents match with only one Korean consonant in their borrowing into Korean. For instance, English words beginning with a voiceless stop are always borrowed with the Korean aspirated stop corresponding to the place of articulation of the English stop (e.g., English *pen* is not [pen] or [p'en] but is [p<sup>h</sup>en] in Korean). However, more than one Korean consonant is used for the borrowing of other English obstruents. English words beginning with a voiced stop are inconsistently borrowed with the tense stops or the lax stops in Korean. For example, the English word *bag* is borrowed with the tense stop [p'] (i.e., [p'ek]), while the English word *biscuit* is borrowed with the lax stop [p] (i.e., [pisik<sup>het</sup>]). The case of English voiceless interdental fricative /θ/ is more interesting. The English expression *thank you* is borrowed as either [t'enk<sup>h</sup>yu] or [s'enk<sup>h</sup>yu]; either the Korean tense stop [t'] or tense fricative [s'] is used for borrowing the English interdental fricative /θ/ into Korean. These inconsistent loanword adaptation patterns of English sounds are problematic under the purely phonological view. If the borrowing process was purely phonological and the borrowers had complete access to the phonology of both languages, varied adaptations of a single sound would not be expected. Varied patterns in loanword adaptation such as those being shown in Korean loanwords from English are difficult to explain without considering perceptual factors in the borrowing process. Nevertheless, it is still difficult to decide to what extent perceptual factors affect the borrowing of English obstruents into Korean.

In order to probe the influence of perceptual factors in loanword phonology, we examined Koreans' perceptual patterns of English sounds from a perceptual experiment, and compared the results from the perceptual experiment with English loanword adaptation patterns in Korean. Steriade (2001b) stated that "the P-map is a set of statements about absolute and relative perceptibility of different contrasts, across the different contexts where they might occur (p.2)".<sup>1</sup> She also suggested that we can know the perceptual salience or the phonological similarity of segments from (1) the observation about confusion of segments by speakers or (2) speakers' a priori knowledge on the factors relevant to similarity.<sup>2</sup> Following her suggestion, we asked Korean

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<sup>1</sup> Steriade claims that some features are more confusable in certain context than others and that the P-map is universal in a sense. Although I agree with her view on salience in certain context, I do not assume either that the fundamental unit of salience is features or that the P-map is universal. Kang (2003) also does not make this assumption although her analysis is based on the P-map account.

<sup>2</sup> Steriade (2001b) also mentioned Shepard's (1972) proposal on how to quantify the similarity between two sounds. This cannot be tested in the case of English loanwords in Korean. In order to apply Shepard's equation, a confusion matrix having the same number of input and output should be generated first. This confusion matrix, however, cannot be generated if the input and the output do not share the same

listeners to judge the similarity between English sounds and Korean ones, then to choose the best matching Korean sounds for the English ones. The results from this cross-language perceptual matching technique show us which native Korean sounds are most similar to English sounds under the P-map hypothesis. Thus, the comparison of the results with actual loanword adaptation patterns in Korean provides a probe for considering to what extent perceptual factors play a role in Korean loanword phonology.

Section 2 examines possible choices for English coronal and labial stops and fricatives in Korean. Section 3 reports how the perceptual experiment was conducted in order to test the P-map in Koreans' borrowing of English obstruents. In section 4, the results from the experiment are given and Koreans' perceptual patterns are compared with their loanword adaptation patterns. In section 5, the results from the experiment and the loanword adaptation patterns of English obstruents in Korean are analyzed under the Optimality Theoretical framework. In this section, two perceptually motivated constraints *BeSimilar[voice]* and *BeSimilar[ConDur]* are proposed based on the results from our perception experiment and other findings in the field of phonetics and speech perception. A possible constraint ranking relationship is also presented in order to account for varied loanword adaptation patterns of English words beginning with labial and coronal obstruents in Korean. In section 6, the perceptual experimental results in intervocalic positions are briefly presented in order to complete the picture of the role of perception in the borrowing process. Section 7 concludes the paper.

## 2. Possible choices in the borrowing of English labial and coronal consonants into Korean

In considering how English labial and coronal obstruent consonants are borrowed into Korean, we must first consider the Korean obstruent inventory. The obstruent inventory of Korean is given in (1).

(1)	lax	p	t	c	k	
	aspirated	p <sup>h</sup>	t <sup>h</sup>	c <sup>h</sup>	k <sup>h</sup>	
	tense	p'	t'	c'	k'	
			s			h
			s'			

Korean stops and coronal sibilant fricatives are roughly similar to their English counterparts in place and manner of articulation. Korean obstruents, however, exhibit a three-way contrast (i.e., tense, lax, and aspirated) rather than a two-way contrast (i.e., voiced and voiceless) as in English. Kim (1970) considered the three-way contrast in Korean as a contrast in laryngeal features; thus, the aspirated and tense obstruents are laryngeally marked, [spread glottis] and [constricted glottis] while the lax series are laryngeally unmarked (Davis & Cho, 2006). There is a view that the two-way contrast in English is also a contrast in laryngeal features. Iverson & Salmons (1995) claim that the

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orthography (i.e., the Roman alphabet). Even between languages sharing the same orthography (e.g., English and French), the results from the equation cannot guarantee that the numbers in the matrix correctly reflect the confusion between sounds in both languages since it is not certain at which level the response process occurs (e.g., at the perceptual level or at the orthographic level?) (Park & de Jong, *in review*).

feature [voice] is redundant in most Germanic languages and the two-way contrast in English is, in fact, a contrast of unmarked voiced with laryngeally marked voiceless obstruents (i.e., [spread glottis]). According to this view, one possible borrowing of English consonants in Korean would involve the matching consonants agreeing in the laryngeal feature. Both Korean aspirated and English voiceless obstruents are marked with [spread glottis] while the Korean lax series and English voiced consonants are laryngeally unmarked. Consequently, it can be predicted that English voiced obstruents would match with Korean lax ones, while English voiceless obstruents would match with Korean aspirated ones in the borrowing process.<sup>3</sup>

However, studies examining Voice Onset Time (VOT) suggest another possible borrowing situation between English and Korean. The VOT values for all Korean obstruents are positive, except for the lax stops between vowels. For example, Han (1996) reports that the mean values of VOT for Korean /pʰ/, /p/, and /pʰ/ were 8.7 ms (SD = 3.2), 45.6 ms (SD = 18.2), and 76.7 ms (SD = 18.2), respectively, in her pilot study with three native Korean males from Seoul.<sup>4</sup> Strictly speaking, both English voiced and voiceless stops also have positive values in VOT. For instance, a typical VOT value for English initial /b/ is about 10ms, and for English /p/ is about 55 ms or more (Ladefoged, 2001:127). If the standard deviation is considered between English and Korean bilabial stops, rough overlaps are expected between English voiced obstruents and Korean tense and possibly lax ones, as well as between English voiceless obstruents and Korean lax and possibly aspirated ones. Therefore, the borrowing of English voiced obstruents as Korean tense and possibly lax ones and the borrowing of English voiceless obstruents as Korean lax and possibly aspirated ones are predicted.<sup>5</sup>

Previous perception studies give a somewhat different prediction. Schmidt (1996) asked 20 Korean learners of English to type the consonant they heard in Korean orthography after they listened to nonsense CV English words consisting of various English consonants combined with three English vowels /i a u/. She reports that the Korean listeners typed the Korean aspirated stops for English voiceless stops (e.g., 97% /pʰ/ responses for English /p/; 93% /tʰ/ responses for English /t/; 88% /kʰ/ responses for English /k/) while they used the Korean lax and tense stops for English voiced ones (e.g., 42% /p/ and 53% /pʰ/ responses for English /b/; 83% /t/ and 17% /tʰ/ responses for English /d/; 49% /k/ and 49% /kʰ/ for English /g/). Therefore, we may predict that Korean lax and tense stops would be used for English voiced obstruents while Korean aspirated ones would be used for English voiceless ones in the borrowing of English sounds in Korean.

The case of English fricative borrowing in Korean is more complicated than that of English stops. English has a wider range of fricatives than Korean, and the place of articulation in the two languages does not match in most cases. Therefore, both manner and place of articulation should be considered in the borrowing process of English

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<sup>3</sup> I thank Stuart Davis for pointing out this possible match based on laryngeal features between the two languages.

<sup>4</sup> In the same pilot study, Han (1996) also reports that the VOT values from another group (e.g., three males from Pusan) were lower than those from Seoul dialect speakers. The mean values of VOT for /pʰ/, /p/, and /pʰ/ were 7.0 ms (SD = 1.1), 14.6 ms (SD = 7.1), and 75.1 (SD = 22.8), respectively (Han, 1996:32).

<sup>5</sup> Silva (2006) reports that younger Korean speakers produced aspirated stops with much lower VOT values; thus the VOT value difference between lax and aspirated stops can be much smaller than that reported in Han (1996).

fricatives into Korean. Although Korean does not have labial fricatives, Korean has labial stops /p/, /pʰ/, or /pʰ/; thus the labial stop series, i.e., /p/, /pʰ/, or /pʰ/, seems like a plausible candidate for borrowing English labiodental fricatives /f/ and /v/ into Korean. The acoustic properties of English /s/ are very similar to Korean /s/; thus, the Korean /s/ series should be likely to be used for the borrowing of English /s/ in Korean. However, the prediction on the case of /s/ is not easy since the aspirate /sʰ/ is missing in the Korean /s/ series.<sup>6</sup> Thus, any prediction on contrast matching between English and Korean should consider this special situation of /s/ borrowing. From the perspective of agreement in laryngeal contrast, Davis & Cho (2006) suggest that the tense /sʰ/ replaces the aspirated /sʰ/ in Korean in situations where it might arise, since both are laryngeally marked;<sup>7</sup> the former is [constricted glottis] and the latter is [spread glottis]. Therefore, we may predict that laryngeally marked English /s/ would be borrowed with the laryngeally marked Korean tense /sʰ/.<sup>8</sup> Another possible prediction based on Schmidt's (1996) perception study is that English /s/ in initial position would be borrowed with Korean lax /s/ or tense /sʰ/. In the same study, Schmidt reports that the Korean listeners typed 67% of /sʰ/ and 32% of /s/ for English CV words consisting of /s/ and three English vowels /i a u/. Therefore, here we have an inconsistent prediction for English /s/ borrowing in Korean.

English /z/ borrowing in Korean is different from the English /s/ case. Although English /z/ is different from English /s/ only in voicing, Korean does not have any coronal fricative other than lax /s/ and tense /sʰ/. Following the laryngeal agreement view, the use of Korean lax /s/ would be predicted for English /z/ since both are laryngeally unmarked. However, the perceptual view predicts that Korean coronal affricate /c/ would be used for English coronal fricative /z/; Schmidt (1996) reports 94% of the Korean listeners' perceptual responses with the coronal lax affricate /c/ for English /z/. The prediction on English interdental fricatives /θ/ and /ð/ is more complicated. English interdental fricatives /θ/ and /ð/ are typologically uncommon sounds and different loanword adaptation patterns have been demonstrated in different languages. Lee (2006) summarizes that [t] or [s] are used in the borrowing of /θ/ in many languages<sup>9</sup> and even [f] substitutes for /θ/ in some cases.<sup>10</sup> Since Korean has both /t/ and /s/ in the phonemic inventory, both might be possible choices for the borrowing of English interdental fricatives in Korean. However, if the Korean /s/ series is used for English /θ/, it is

<sup>6</sup> Iverson (1983) describes Korean /s/ as having laryngeal features of both the lax and the aspirated series (e.g., both Korean /s/ and the aspirated ones are [+spread glottis]) although its phonological pattern follows the lax series.

<sup>7</sup> Discussion of /s/ borrowing is restricted to English /s/ in a singleton in this paper. See Davis & Cho (2006), Kim & Curtis (2002), and Lee & Iverson (2007) for further discussion on English /s/ borrowing in Korean, including the borrowing case of English /s/ in a consonant cluster.

<sup>8</sup> Vaux (1998) argues that the typologically unmarked laryngeal state of voiceless fricatives is [+spread glottis] while that of voiced fricatives is [-spread glottis]. The term "unmarked", however, is used differently in Davis & Cho (2006) and Vaux (1998) since Davis & Cho (2006) use the term "unmarked" as that the feature X is not marked as [+X] without any assumption of "typological unmarkedness".

<sup>9</sup> Lee (2006) summarizes that Thai, Russian, Hungarian, Serbo-Croatian, Tagalog, Moroccan Arabic, Quebec French, and Xhosa use [t] for /θ/ borrowing while Japanese, German, Egyptian Arabic, and European French use [s].

<sup>10</sup> Lee (2006) reports that [t] is used for the borrowing of /θ/ in word-initial position in Mandarin while [f] is used in word-final position. She also reports that [t] and [d] substitute for English /θ/ and /ð/ in word-initial position in varieties of African-American Vernacular English while [f] and [v] are used in other prosodic positions.

possible that the Korean sound used for English /z/ might also be used for English /ð/ since a language that uses /s/ for /θ/ often uses /z/ for /ð/. Another possible choice for English fricatives /θ/ and /ð/ would be the Korean labial stop series, i.e., /p/, /pʰ/, or /pʰ/, if we consider the connection between /f/ and /v/ with the labial stops in Korean.

### 3. Koreans' perception of English stops and fricatives in onset and intervocalic positions

The P-map account predicts that a sound in the source language is adapted into the recipient language in a way that maximizes the similarity between the two sounds. Thus, one way to test the P-map account in loanword phonology is to find the most similar pair of sounds in the source and the recipient language. For this purpose, we used the orthographic classification technique and asked the borrowers to choose the closest native sounds after they listened to sounds in the source language. The orthographic classification technique asks subjects to use a phonemic native orthographic system for the response labels so that non-native categories can be tapped into the native categories. Therefore, this technique seems to be most suitable for the purpose of finding the most similar match between the sounds in two languages (e.g., Wiik, 1965; Flege, 1991; Schmidt, 1996; Park & de Jong, *in review*). In addition, Korean orthography is phonemic and is completely different from Roman alphabets. Therefore, the Korean listeners' choices would clearly demonstrate the closest native Korean sounds to English sounds. Our perceptual experiment with the orthographic classification technique would lay a foundation for testing the P-map account in Korean loanword phonology.

#### 3.1. Talker and Stimuli

Two male and two female native speakers of American English produced the stimuli for the perceptual experiment. All four speakers were in their late 20's and had a residential history dominated by the Northern Mid-west. The speakers were asked to read a randomized list of nonsense words consisting of the vowel /a/ and 10 English labial and coronal consonants /p b f v t d s z θ ð/ in three prosodic locations such as word onset, pre-stressed intervocalic and post-stressed intervocalic positions (e.g., /pa/, /ba/, /ápa/, /ába/, /apá/, /abá/, etc.).<sup>11</sup> The stimuli were recorded in a sound-attenuated recording room of the Linguistics Department at Indiana University, using an Electro Voice (model RE50) standing microphone and a TASCAM DA-30 MKII DAT recorder. The recordings were then transferred from DAT to a G4 Macintosh computer in the Linguistic Speech Lab at Indiana University for editing.

#### 3.2. Listeners<sup>12</sup>

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<sup>11</sup> The perceptual experiment included more consonants than those presented in this paper and it also included consonants in coda position. However, only partial results are reported in this paper. Nevertheless, velar obstruents were not in the corpus in the study, thus they should be included in the future research in order to complete the P-map between English and Korean obstruents.

<sup>12</sup> Forty-two Korean listeners and 19 American listeners originally participated in the study. However, two Korean listeners and two American listeners either did not follow the instructions or did not perform the task as expected (e.g., only one choice for all the stimuli).



The results from the control group were used to check the stimuli in the perception experiment with the Korean listeners.

#### 4. Korean loanword adaptation of English stops and fricatives in onset position

##### 4.1. Results

In this section, only the results from the word-initial position are discussed. Most Korean listeners agreed on the choice of the Korean consonant for at least some English consonants. For example, among English stops, 95% of the choices for English /p/ were /p<sup>h</sup>/ and 98% for English /t/ were /t<sup>h</sup>/. Among English fricatives, 89% of the listeners' choices for English /s/ were /s<sup>ʰ</sup>/ and 95% for English /z/ were /c/. However, Korean listeners' judgments on some English consonants were divided. For instance, for English /b/, 46% of the choices were /p<sup>ʰ</sup>/ while 41% were /p/. The same lax/tense division has been observed in the judgment of English /d/. 85% of the choices were /t/ while 14% were /t<sup>ʰ</sup>/.

Koreans' choices for some English fricatives showed that the division can be between tense consonants and aspirated ones, or across manner or place of articulation. Koreans' choices for English /f/ showed tense/aspirated confusion. 56% of the choices for English /f/ were /p<sup>h</sup>/ while /p<sup>ʰ</sup>/ responses made up 24% of the answers. Confusion across place of articulation was demonstrated in the cases of /ð/ and /v/. 79% of the choices for English /ð/ were /t/, while 15% were /p/. 68% of the responses for English /v/ were labeled /p/ while 19% were labeled /t/. The results of Koreans' choice for English /θ/ showed confusion across manner of articulation and place of articulation as well. 40% of Koreans' choices was /s<sup>ʰ</sup>/ for English /θ/ while 24% and 16% were /t<sup>ʰ</sup>/ and /p<sup>h</sup>/, respectively.<sup>13</sup> These results are summarized in Table I.

Korean	English consonants									
	/p/	/b/	/f/	/v/	/t/	/d/	/s/	/z/	/θ/	/ð/
/p/		41	8	65			1			15
/p <sup>ʰ</sup> /		46	23						7	
/p <sup>h</sup> /	95	8	54						16	1
/t/		1		18		84		2	7	78
/t <sup>ʰ</sup> /						14	1		24	1
/t <sup>h</sup> /	1				98					
/L/				6						
/s/							2		4	
/s <sup>ʰ</sup> /			4	2			89		40	
/c/					1		6	95		
/c <sup>ʰ</sup> /							2	3		
/c <sup>h</sup> /										
/m/										
/h/	1	2	5	1						1
Others		2	4	5						2

Table I. Matrix showing percentage labeling of English initial consonants with Korean consonants. Judgments totaling less than 1% are not shown. Each stimulus had approximately 160 tokens (4 talkers × 40 listeners) for the analysis.

<sup>13</sup> Perceptual confusion is also observed among the native speakers of American English listeners in the control group. 21% of /f/, 13% of /v/, and 15% of /ð/ consisted of the responses for /θ/, /ð/, and /v/, respectively, in word initial position.

4.2. What do perceptual results tell us regarding the P-map and loanword grammar in Korean?

First, it is clear that the P-map cannot explain all of the adaptation patterns. Some English sounds were perceived as a segment produced with a different place of articulation.<sup>14</sup> However, such perception patterns are not displayed in loanword adaptation patterns of those segments. For instance, some English fricatives were perceived as Korean consonants having a different place of articulation from their English counterpart (e.g., English /v/ as /t/ (19%) in Korean, English /ð/ as /p/ (15%) in Korean). Yet, there are no cases of either lax [t] for English /v/ or lax [p] for English /ð/ in Korean loanwords. This demonstrates that the faithfulness constraint *Ident(place)* is operating and also is undominated in Korean loanword grammar.

Second, the P-map plays a certain role in Korean loanword phonology to some extent. The results from the perceptual experiment suggest that English voiced stops are most similar to Korean lax and tense stops with a corresponding place of articulation while English voiceless stops are most similar to Korean aspirated stops. Therefore, the P-map would choose two alternatives for English voiced stops and just one for English voiceless ones. The predictions under the P-map account seem to agree with the borrowing of English words into Korean. English words beginning with voiced stops /b/ or /d/ are borrowed with the lax or tense stops in Korean while the aspirated stops are used for the borrowing of English words beginning with voiceless stops /p/ or /t/. Examples are given in (4).

- |     |        |  |  |
|-----|--------|--|--|
| (4) | a. /p/ | pen [p <sup>h</sup> en]                        | pad [p <sup>h</sup> e.ti]                              |
|     | b. /t/ | tomata [t <sup>h</sup> o.ma. t <sup>h</sup> o] | toll gate [t <sup>h</sup> ol.ke.i.t <sup>h</sup> i]    |
|     | c. /b/ | badge [p <sup>h</sup> 'e.c'i]                  | bar [p <sup>h</sup> 'a]                                |
|     | d. /b/ | biscuit [pi.s.i.ket]                           | button [pə.t <sup>h</sup> in]                          |
|     | e. /d/ | dance [t <sup>h</sup> 'en.s'ɔ]                 | dollar [t <sup>h</sup> 'al.lə]/[t <sup>h</sup> 'al.la] |
|     | f. /d/ | dilemma [til.le.ma]                            | dogma [to.gi.ma]                                       |

Under the Optimality Theoretical framework, a classic constraint such as *Ident[voice]* will not capture this English-Korean match shown in the perceptual results (i.e., English voiced stops with Korean voiceless lax and tense stops, English voiceless stops with Korean voiceless aspirated stops) since all series of Korean consonants, which are tense, lax, and aspirated, are phonemically voiceless, resulting in the violation of *Ident[voice]* for any voiced English consonants. However, the P-map account gives explanation on varied adaptation patterns of English voiced sounds;<sup>15</sup> Korean lax and tense stops are

<sup>14</sup> This confusion of place of articulation is very common in speech perception. Miller & Nicely (1955) reported that place of articulation is more confusable than voicing even among native speakers of English when they heard English sounds. Our results from the control group of 17 native speakers of English confirmed that place was just as easily confused among native speakers of English as it was among native speakers of Korean.

<sup>15</sup> There is a view that the expansion of tense consonants at the expense of lax ones may contribute to the varied adaptation patterns of English voiced sounds in Korean loanword phonology (see Shin & Davis, 2004).

used in the borrowing process since both of them are perceptually similar to English voiced obstruents.

## 5. Optimality Theoretic analysis – the role of perceptually motivated constraints

In section 4.2, it was suggested that both the P-map and non-perceptual factors such as *Ident(place)* should be considered in Korean loanword phonology. In this section, that proposal is expanded and some constraints under the Optimality Theoretic framework are provided in order to explain Korean loanword adaptation patterns from English words. The proposed constraints are first presented in (5). Then, explanations for proposing these constraints follow.

- (5) Constraints<sup>16</sup>
- a. *Ident(place)*: Correspondents in input and output have identical place features.
  - b. \*Cont: Fricatives are not allowed.
  - c. *BeSimilar[voice]*: Consonants in correspondence should be similar in voicing.<sup>17</sup>

The correspondence of *BeSimilar[voice]* is:

- English voiced obstruents correspond to Korean lax and tense obstruents.
- English voiceless obstruents correspond to Korean aspirated obstruents. However, [sʰ] instead of /sʰ/, corresponds to English voiceless obstruents in perception of [voice].

- d. *BeSimilar[ConDur]*: Consonants in correspondence should be similar in duration.

The correspondence of *BeSimilar[ConDur]* is:

- English stops and voiced fricatives correspond to Korean lax or aspirated obstruents.
- English voiceless fricatives correspond to Korean tense obstruents.<sup>18</sup>

Although Korean listeners often perceived some English fricatives as having a different place of articulation (i.e., English /v/ as Korean /t/, English /ð/ as Korean /p/, English /θ/ as Korean /pʰ/ or /p/), such perception patterns are never reflected in adaptation of English fricatives in Korean. Therefore, it seems that the faithfulness constraint *Ident(place)* is actively operating in Korean loanword phonology and that it is undominated.

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<sup>16</sup> Although I do not include other constraints such as \*f, \*v, \*θ, \*ð, and \*z. I assume that these constraints are undominated in Korean grammar.

<sup>17</sup> Although *BeSimilar[voice]* was stated following Kang (2003), the details of the constraint are different. Kang's (2003) *BeSimilar[voice]* states: "Strings of sounds in correspondence should be similar in stop voicing and vowel length (p.253)."

<sup>18</sup> Although English affricates are not considered in this paper, they may correspond to Korean lax and aspirated series.

Lee (2006) suggested that *\*Cont* and *\*Stop* are relevant in explaining loanword adaptation patterns in Korean. She claimed that the universal ranking between *\*Cont* and *\*Stop*, that is, *\*Stop* is dominated by *\*Cont*, is working for the choice of a winning candidate in Korean loanword phonology.<sup>19</sup> I also propose that *\*Cont* is operating in the borrowing of English words into Korean. However, the operation of *\*Cont* is different in selection of the winning candidate.

In section 4.2, I argued that *Ident[voice]* is not appropriate in explaining the borrowing process in Korean. One reason is that *Ident[voice]* will be violated by any choice of Korean consonants for voiced English consonants since all Korean obstruents are phonemically voiceless. Another reason against operating of *Ident[voice]* in Korean loanword phonology is that *Ident[voice]* would not capture the general patterns of the borrowing of English voiced and voiceless obstruents in Korean; English voiced stops are borrowed with Korean lax or tense stops while English voiceless ones are with Korean aspirated ones. This voicing distinction of English sounds is also well reflected in Korean orthography (Lim, Nagao, & de Jong, 2003). It seems that the P-map demonstrated by the perceptual experiment reflects this apparent match between the English two-way contrast with Korean three-way contrast. The results from the perceptual experiment showed that Koreans used the aspirated series for English voiceless stops, while they used the tense or lax series for English voiced ones (e.g., Korean /p<sup>h</sup>/ for English /p/, while Korean /p/ and /p<sup>ʰ</sup>/ for English /b/). Therefore, I propose the perceptually motivated constraint *BeSimilar[voice]* in order to include these apparent Korean loanword adaptation patterns for English voiced and voiceless obstruents, which are also clearly reflected by Koreans' perception of English sounds. Although *BeSimilar[voice]* is perceptually motivated in the first place, this constraint also concerns factors related to Korean internal phonology. It is well known that the aspirated /s<sup>h</sup>/ is missing in Korean; that is, fricatives only have a two-way laryngeal contrast – tense and lax – unlike the three-way laryngeal contrast found with stops (Iverson, 1983). On this special situation, Davis & Cho (2006) proposed that [s<sup>ʰ</sup>] appears in positions where [s<sup>h</sup>] is expected. Their claim starts with the observation that both aspirated and tense consonants are laryngeally marked; an aspirated one is marked with the feature [spread glottis] and a tense is marked with the feature [constricted glottis]. They also noticed that tense [s<sup>ʰ</sup>] appears instead of [s<sup>h</sup>] in positions where laryngeal feature [spread glottis] is expected to be realized on /s/ in Korean native words.<sup>20</sup> They argued that this [s<sup>ʰ</sup>] instead of [s<sup>h</sup>] is a repair strategy in native words as

<sup>19</sup> Lee (2006) supported her claim by typological distribution of sounds and by acquisition data in child phonology and interlanguage phonology.

<sup>20</sup> Davis & Cho (2006) observed that laryngeal feature [spread glottis] is preserved and it is realized as the aspirated stops as in (i). They also noticed that tense [s<sup>ʰ</sup>] appears in positions where [spread glottis] is expected to be preserved and realized as in (ii) (Davis & Cho, 2006:1015)

(i) Korean h-deletion before a following stop

<u>Underlying Forms</u>	<u>Phonetic Forms</u>	<u>Gloss</u>
a. /nah + ta/	[na.t <sup>h</sup> a]	'give birth'
b. /coh + ko/	[co.k <sup>h</sup> o]	'like (and)'

(ii) Korean h-deletion before /s/.

<u>Underlying Forms</u>	<u>Phonetic Forms</u>	<u>Gloss</u>
a. /noh + so/	[no.s <sup>ʰ</sup> o]	'put it'
b. /coh + so/	[co.s <sup>ʰ</sup> o]	'good idea (I like it)'

well as in /s/-final loanwords from English, in order that a laryngeal feature surfaces. The results from the perceptual experiment seem to support their claim. In the perceptual experiment, English *voiceless* stops were perceived as the Korean *aspirated* stops. Therefore, we may predict that English *voiceless* fricatives would be perceived as Korean *aspirated* fricatives, which do not exist in Korean. The results from the experiment showed that voiceless fricatives such as /θ/ and /s/ were often perceived as /sʰ/ (e.g., 40% and 89% of the responses for English /θ/ and /s/, respectively, were Korean /sʰ/) while never as lax /s/. These results, thus, suggest that [sʰ] replaces the aspirated [sʰ] in Koreans' perception. Following Davis & Cho's (2006) proposal and the results from our perceptual experiment, therefore, I propose that the /s/ series should be treated differently from other obstruents in Korean and that the tense [sʰ] replaces aspirated [sʰ] in *BeSimilar[voice]*.<sup>21</sup>

I propose that another perceptually motivated constraint *BeSimilar[ConDur]* is also operating in Korean loanword phonology. One observation from the perceptual results is that voiceless fricatives were often perceived as tense consonants (e.g., English /θ/ as Korean /sʰ/ (40%), /tʰ/ (24%) and /pʰ/ (7%), English /f/ as Korean /pʰ/ (24%), English /s/ as Korean /sʰ/ (89%)), whereas voiced fricatives were hardly perceived as tense ones (i.e., no tense response for English /ð/, /v/, and /z/). This bias against the tense responses for English voiced fricatives seems to agree with the Koreans' borrowing of English voiced fricatives. English words beginning with voiced fricatives are mostly borrowed with the Korean lax consonants and the varied adaptation between the tense and the lax stops are not observed as in the borrowing of English voiced stops. The examples of loanwords from English words beginning with voiced fricatives are given in (6).

- (6) a. /ð/ this [ti.sʰi] that [tet]  
 b. /v/ van [pen] valve [pel.pʰi]  
 c. /z/ zero [ce.ro] zipper [ci.pʰə]

The prediction based on agreement of laryngeal markedness (in section 2) may account for why English voiced fricatives are borrowed with the Korean lax consonants; both English voiced fricatives and Korean lax obstruents are laryngeally unmarked. However, this laryngeal view cannot explain the following adaptation pattern in (7).

- (7) /θ/ thank you [tʰeŋ.kʰyu]/ [sʰeŋ.kʰyu] think [tʰin.kʰi]/[sʰin.kʰi]

The English word beginning with /θ/ *thank you* is borrowed with either the Korean coronal tense stop /tʰ/ (i.e., [tʰeŋ.kʰyu]) or the Korean coronal tense fricative /sʰ/ (i.e., [sʰeŋ.kʰyu]) as in (7). We may explain the use of /sʰ/ for the borrowing of English voiceless fricative /θ/ if we assume that [sʰ] replaces [sʰ]. Without consideration of the P-map or the perceptual results, however, it is difficult to explain why Korean tense /tʰ/ is used rather than the lax /t/, which is typologically the more common substitution for the

<sup>21</sup> The perceptual results might also be explained with agreement of laryngeal markedness in the two languages (Stuart Davis, *personal communication*). However, the constraint *BeSimilar[voice]* will be used in this paper in order to emphasize the role of perception or the P-map in loanword phonology rather than purely phonological feature matching.

English /θ/, or the aspirated /t<sup>h</sup>/, which is the better match in laryngeal feature with English voiceless obstruents. The results from the perceptual experiment suggest that the P-map guides Korean listeners to choose the Korean tense stops for the most similar match with some English voiceless fricatives, whereas it directs the Koreans to choose Korean lax stops for English voiced fricatives.

One possible explanation for this cross-language match between English voiceless fricatives and Korean tense obstruents is the perceptual similarity in consonant duration. Denes (1955), Ladefoged (2001:53), and Lee & Iverson (2007) reported that English voiceless fricatives are longer than the voiced ones in coda position. Additionally, the duration of the consonant will be longer in fricatives than in stops if we consider the frication in fricatives as comparable to the consonant closure in stops. Thus, we may conclude that the consonant duration is longest in voiceless fricatives compared to other obstruents in English. In Korean, tense consonants are the longest in consonant duration. For example, Kagaya (1974) reported that the timing of the closing gesture of tense consonants is longer than that of lax ones. Dart (1987) and Han (1996)<sup>22</sup> also reported the same observation on the duration of the tense and the lax consonants. More recently, Kim & Curtis (2001) reported that the frication of /s<sup>ʰ</sup>/ is longer than that of /s/ in word-initial and word-final position. Their perceptual experiment also demonstrated that Koreans were sensitive to the consonant duration of [s]. The same results were also reported in Lee & Iverson (2007). In addition to these phonetically oriented researches, theoretically oriented phonologists such as Ahn & Iverson (2004) also claimed that the tense consonants in Korean are phonologically geminates and phonetically longer than the lax ones. Iverson & Lee (2004) also accepted the geminate view of tense consonants in Korean as they argued that Koreans' sensitivity to consonant duration results in varied adaptation between the tense and lax /s/ for English /s/ borrowing into Korean. All these observations and findings indicate that Korean tense consonants and English voiceless fricatives are longer than other Korean and English obstruents, respectively. Koreans' sensitivity to this relative consonant duration difference in the two languages seems to play a role in loanword adaptation patterns. Thus, I propose the perceptually motivated constraint *BeSimilar[ConDur]*.

Now let us examine how these constraints are operating in Korean loanword phonology.<sup>23</sup> First, *BeSimilar[voice]* guides us to choose a correct winner for English stops and it explains varied adaptation patterns of English voiced stops in Korean. The English loanwords beginning with a stop were provided in (4) and they are repeated in (8).

- |     |        |  |  |
|-----|--------|--|--|
| (8) | a. /p/ | pen [p <sup>h</sup> en]                        | pad [p <sup>h</sup> e.ti]                            |
|     | b. /t/ | tomata [t <sup>h</sup> o.ma. t <sup>h</sup> o] | toll gate [t <sup>h</sup> ol.ke.i.t <sup>h</sup> i]  |
|     | c. /b/ | badge [p <sup>ʰ</sup> e.c <sup>ʰ</sup> i]      | bag [p <sup>ʰ</sup> ek]                              |
|     | d. /b/ | biscuit [pi.sɪ.ket]                            | button [pə.t <sup>h</sup> in]                        |
|     | e. /d/ | dance [t <sup>ʰ</sup> en.s <sup>ʰ</sup> i]     | dollar [t <sup>ʰ</sup> al.lə]/[t <sup>ʰ</sup> al.la] |

<sup>22</sup> Han (1996) reported that closure duration of /p<sup>ʰ</sup>/ is longer than that of /p<sup>h</sup>/, and that of /p<sup>h</sup>/ is longer than that of /p/. All the differences were statistically significant (p.28).

<sup>23</sup> *Ident(place)* is assumed to be undominated in the ranking relationship with other constraints; thus, possible candidates violating *Ident(place)* will not be considered in the analysis.

f. /d/ dilemma [til.le.ma]

dogma [to.gi.ma]

As we can see in (8a) and (8b), English voiceless stops are adapted as aspirated stops in Korean.<sup>24</sup> However, English voiced stops /b/ and /d/ are adapted as either a lax stop or a tense stop in Korean.<sup>25</sup> For example, /b/ in English word *bag* is adapted as [pʰ] as in (8c) while /b/ in *button* is adapted as [p] as in (8d). Such tense/lax variations for English voiced stops are also shown in (8e) and (8f). These varied adaptation patterns can be explained well by the constraint *BeSimilar[voice]*. The selection process of the winning candidates for English stops are described in Tableaux (9) and (10).

(9) English voiceless /p/ in word initial position: *BeSimilar[voice]*

/pV/ <sup>26</sup>	<i>BeSimilar[voice]</i>
a. pV	*!
b. pʰV	*!
☞ c. p <sup>h</sup> V	

(10) English voiced /b/ in word initial position: *BeSimilar[voice]*

/bV/	<i>BeSimilar[voice]</i>
☞ a. pV	
☞ b. pʰV	
c. p <sup>h</sup> V	*!

As we can see in Tableau (9), *BeSimilar[voice]* limits the match of English voiceless obstruents to Korean aspirated obstruents; thus for English voiceless stop /p/, (9c) containing an aspirated [p<sup>h</sup>] becomes the winning candidate over both (9a) and (9b) violating *BeSimilar[voice]*. However, in Tableau (10), the candidate (10c) [p<sup>h</sup>] loses over candidates (10a) lax [p] and (10b) tense [pʰ] for English voiced bilabial /b/; the relevant constraint, *BeSimilar[voice]*, states that only the lax and the tense stops correspond to English voiced stops. In the case of English voiced stops, therefore, either a lax stop or a tense one can be the winner.<sup>27</sup>

We need to consider the interaction between *BeSimilar[voice]* and other constraints *BeSimilar[ConDur]* and *\*Cont* for the selection of the correct winner for English fricatives. The English loanwords beginning with voiceless fricatives are given in (11).

- (11) a. /θ/ thank you [tʰeŋ.kʰyu]/ [sʰeŋ.kʰyu] think [tʰin.kʰi]/[sʰin.kʰi]  
 b. /f/ fax [pʰek.sʰi] form [pʰom]  
 c. /s/ siren [sʰa.i.ren] sign [sʰa.in]

<sup>24</sup> There are a few words which contain a tense stop used for a voiceless stop. For instance, the English word *pornography* is borrowed with the short form of the word, [pʰo.ri.no] in Korean. However, it is not clear whether this word is directly borrowed from English or through other languages such as Japanese. Voiceless stops from other languages such as French, Italian, or Spanish are often borrowed with tense stops in Korean.

<sup>25</sup> Standard Korean orthography for English voiced stops is a lax series. For example, the English word ‘bag’ is written as ‘pek’ although it is pronounced as [pʰek].

<sup>26</sup> /pV/ indicates /p/ in word initial position.

<sup>27</sup> I do not propose how tense stops are selected over lax ones or vice versa in this paper.

English voiceless interdental fricative /θ/ is borrowed with [tʰ] or [sʰ] in Korean as in (11a). Although [sʰ] will be selected as the winning candidate by *BeSimilar[voice]*, *BeSimilar[voice]* will incorrectly select [tʰ] as optimal as well. Furthermore, [tʰ] will not be selected at all by *BeSimilar[voice]* since the English voiceless interdental fricative /θ/ only corresponds to [sʰ] or aspirated stops according to *BeSimilar[voice]*. This selection process is well demonstrated in Tableau (12).

(12) English voiceless interdental fricative /θ/ in word initial position: *BeSimilar[voice]*

/θV/	<i>BeSimilar[voice]</i>
a. sV	*!
☞ b. sʰV	
c. tV	*!
☞ d. tʰV	*!
☹ e. tʰV	

*BeSimilar[voice]* states that English voiceless obstruents correspond to Korean aspirated obstruents in general. It also allows the match between English voiceless obstruents and Korean [sʰ] due to the special situation of the Korean /s/ series. Therefore, only the aspirated obstruent candidate (12e) [tʰ] and the exceptional case (12b) [sʰ] satisfy *BeSimilar[voice]* for English voiceless interdental fricative /θ/, whereas the other candidates, including (12d) [tʰ], do not. The English /θ/, however, is borrowed with the Korean [sʰ] or [tʰ] rather than [tʰ]; thus, other constraints must be operating in the borrowing process. In order to choose [tʰ] over [tʰ] for English /θ/, *BeSimilar[ConDur]* should be ranked higher than *BeSimilar[voice]*. The selection between [sʰ] and [tʰ], then, can be explained by the ranking relationship between *\*Cont* and *BeSimilar[voice]*. When *\*Cont* is higher than *BeSimilar[voice]* in the ranking relationship, [tʰ] will be selected as the optimal candidate. However, [sʰ] will win over [tʰ] when the constraint ranking between these two are reversed. The selection process of the optimal candidate depending on different rankings between *BeSimilar[voice]* and *\*Cont* is shown in Tableaux (13) and (14).

(13) English /θ/ in word initial position: *BeSimilar[ConDur]* >> *BeSimilar[voice]* >> *\*Cont*

/θV/	<i>BeSimilar[ConDur]</i>	<i>BeSimilar[voice]</i>	<i>*Cont</i>
a. s	*!	*	*
☞ b. sʰ			*
c. t	*!	*	
d. tʰ		*!	
e. tʰ	*!		

(14) English /θ/ in word initial position: *BeSimilar[ConDur]* >> *\*Cont* >> *BeSimilar[voice]*

/θV/	<i>BeSimilar[ConDur]</i>	<i>*Cont</i>	<i>BeSimilar[voice]</i>
a. s	*!	*	*
b. sʰ		*!	
c. t	*!		*
☞ d. tʰ			*
e. tʰ	*!		

When *BeSimilar[ConDur]* is ranked higher than *BeSimilar[voice]*, the tense consonant candidates [s'] and [t'] win over the other candidates, including [t<sup>h</sup>], as shown in Tableaux (13) and (14). *BeSimilar[ConDur]* states that English voiceless fricatives correspond to Korean tense obstruents in duration. Therefore, the candidates [t'] (e.g., (13d) and (14d)) and [s'] (e.g., (13b) and (14b)) satisfy *BeSimilar[ConDur]* while the other candidates do not. Then, the selection of the optimal candidate between these two surviving candidates depends on the ranking relationship between *\*Cont* and *BeSimilar[voice]*. When *BeSimilar[voice]* is ranked higher than *\*Cont* as in (13), the candidate (13b) [s'] will be the optimal candidate, since only the aspirate consonants and [s'] actually satisfy the constraint *BeSimilar[voice]*. However, if *\*Cont* is ranked higher than *BeSimilar[voice]* as in (14), the candidate (14d) [t'] will win over the candidate (14b) [s'] since the candidate (14b) [s'] violates *\*Cont*, which disallows fricatives.

Our proposal of the different ranking relationship between *\*Cont* and the perceptually motivated constraint *BeSimilar[voice]* is well grounded. It is well known in speech perception literature that each individual is different in their strategy for perceiving speech sound. For example, Kim, Beddor, & Horrocks (2002) report that some Korean listeners decided tense vs. aspirated stop distinction based on the consonant portion of the monosyllabic words, while others did it based on the vowel portion.<sup>28</sup> If we consider this individual variation in speech perception under the Optimality Theoretical framework, a flexible ranking of a constraint related to speech perception makes more sense.

Such an unstable or unfixed ranking relationship of perceptually motivated constraints is also observed in the borrowing of other English fricatives in Korean. One example is given in Tableaux (15) and (16).

(15) English /f/ in word initial position: *BeSimilar[ConDur]* >> *BeSimilar[voice]*

/fV/	<i>BeSimilar[ConDur]</i>	<i>BeSimilar[voice]</i>
a. p	*!	*
⊖ b. p'		*
c. p <sup>h</sup>	*!	

(16) English /f/ in word initial position: *BeSimilar[voice]* >> *BeSimilar[ConDur]*

/fV/	<i>BeSimilar[voice]</i>	<i>BeSimilar[ConDur]</i>
a. p	*!	*
b. p'	*!	
☞ c. p <sup>h</sup>		*

The English voiceless labiodental fricative /f/ is always borrowed with the Korean tense stop /p<sup>h</sup>/ as in (11b). For example, the English word *form* is borrowed with [p<sup>h</sup>om] as in (11b). If we assume that *BeSimilar[ConDur]* is ranked higher than *BeSimilar[voice]* as in (13) and (14), [p'] , rather than [p<sup>h</sup>], will be incorrectly selected as the optimal candidate for English /f/ as in Tableau (15). This is because *BeSimilar[ConDur]* requires the Korean tense consonants such as (15b) [p'] for English voiceless fricatives such as

<sup>28</sup> Kim *et al* (2002) had Korean listeners listen to synthetic words including conflicting parts for tense vs. aspirated CV words. The stimuli included the consonant part of a tense stop with a vowel portion of aspirated stop and the consonant portion of the aspirated stop with the vowel portion of the tense stop.

English /f/. When *BeSimilar[voice]* dominates *BeSimilar[ConDur]* in the ranking relationship, however, Korean tense stop [p<sup>h</sup>] will be correctly chosen as the optimal winner as in Tableau (16). Although the winning candidate (16c) [p<sup>h</sup>] violates *BeSimilar[ConDur]*, it does not violate *BeSimilar[voice]* as the other candidates do. Again, if we remember that these constraints are *perceptually* motivated, this reversed ranking relationship of *BeSimilar* constraints makes more sense; the ranking of the perceptually motivated constraints is not as strongly fixed as the ranking of the other classical constraints.

The case of English /s/ adaptation in Korean further illustrates this flexible ranking relationship between perceptually motivated constraints. English /s/ in word initial position is always borrowed with the Korean tense coronal fricative /sʰ/ as in (11c).<sup>29</sup> Under our analysis based on perceptually motivated *BeSimilar* constraints, the ranking relationship between *BeSimilar[ConDur]* and *BeSimilar[voice]* does not affect the correct selection of the optimal candidate for English /s/. The selection process for English /s/ is given in Tableau (17).

(17) English /s/ in word initial position: *BeSimilar[ConDur]*, *BeSimilar[voice]*

/sV/	<i>BeSimilar[ConDur]</i>	<i>BeSimilar[voice]</i>
a. s	*!	*
b. sʰ		
c. t	*!	*
d. tʰ		*!
e. t <sup>h</sup>	*!	

As shown in Tableau (17), (17b) [sʰ] will be selected as the optimal candidate regardless of the ranking relationship between these two constraints, since (17b) does not violate any of *BeSimilar* constraints.

This analysis based on three constraints (i.e., *BeSimilar[voice]*, *BeSimilar[ConDur]*, and *\*Cont*) can also account for the borrowing of English voiced fricatives in Korean. The Korean loanword examples from English words beginning with English voiced fricatives were given in (6) and they are repeated in (18).

- (18) a. /ð/ this [ti.sʰi]                      that [tet]  
 b. /v/ van [pen]                              valve [pel.pi]  
 c. /z/ zero [ce.ro]                           zipper [ci.p<sup>h</sup>ə]

English voiced fricatives are all borrowed with Korean lax obstruents; English /ð/ is borrowed with the Korean lax [t] as in (18a), English /v/ with the Korean lax [p] as in (18b), and English /z/ with the Korean lax [c] as in (18c).<sup>30</sup> The selection processes of the optimal winner for English voiced fricatives are described in Tableaux (19) to (21).

<sup>29</sup> English /s/ in a consonant cluster is borrowed with Korean lax fricative /s/ (Davis & Cho, 2006; Iverson & Lee, 2004; Kim & Curtis, 2002).

<sup>30</sup> This paper does not discuss why coronal lax affricate /c/ is chosen over the coronal lax stop /t/ for the borrowing of English /z/ in Korean. Possible reasons might be related to the similarity between English voiced fricatives and Korean lax affricates or to a large functional load of the lax /t/ in Korean loanwords. Lee (2006)'s suggestion on the universal ranking relationship between *\*Cont* and *\*Stop* is also one of

(19) English /ð/ in word initial position: BeSimilar[ConDur], BeSimilar[voice] >> \*Cont

/ðV/	BeSimilar[ConDur]	BeSimilar[voice]	*Cont
a. s			*!
b. s'	*!	*	*
☞ c. t			
d. t'	*!		
e. t <sup>h</sup>		*!	

(20) English /v/ in word initial position: BeSimilar[ConDur], BeSimilar[voice] >>\*Cont

/vV/	BeSimilar[ConDur]	BeSimilar[voice]	*Cont
☞ a. p			
b. p'	*!		
c. p <sup>h</sup>		*!	

(21) English /z/ in word initial position: BeSimilar[ConDur], BeSimilar[voice] >>\*Cont

/zV/	BeSimilar[ConDur]	BeSimilar[voice]	*Cont
a. s			*!
b. s'	*!	*	*
☞ c. c			
d. c'	*!		
e. c <sup>h</sup>		*!	

All the cases of English voiced fricative borrowing show the flexible ranking relationship between two perceptually motivated constraints. Their rankings would not affect the selection process of the correct optimal winner. It is also noteworthy that the selection of the optimal candidates for English /ð/ and /z/ has been decided, not by perceptually motivated constraints, but by the more universal constraint *\*Cont* as in Tableaux (19) and (21), respectively. As we have seen in (14), the selection of [t'] over [s'] for English /θ/ as the optimal choice was not decided by perceptually motivated constraints only, but by the interaction between perceptually motivated constraint *BeSimilar[voice]* and *\*Cont*. These cases demonstrate well that although most patterns of loanword adaptation, including variations, can be explained by the P-map or the perceptual factors, non-perceptual factors such as *\*Cont* cannot be overlooked in loanword phonology.

## 6. Korean loanword adaptation of English stops and fricatives in intervocalic position

We have considered the influence of perceptually motivated constraints in Korean loanword phonology and such constraints could explain the varied adaptation patterns. *BeSimilar[voice]*, in particular, well captured the varied adaptation patterns of English voiced stops in Korean. The P-map constraint *BeSimilar[voice]*, however, is not complete unless we consider other contexts such as prosodic locations. Again, the essence of the P-

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possibilities: *\*Cont* >> *\*Stop*, i.e., the choice of stop /t/ would violate *\*Stop* while the affricate /c/, technically, would not violate either *\*Cont* or *\*Stop*.

map account is that the perceptibility of a certain contrast can be different in different contexts. Therefore, it is necessary to see borrowers' perceptual patterns of foreign sounds in different contexts. Our perceptual experiment included the stimuli in three different prosodic locations, that is, English stops and fricatives in word-initial, pre- and post-stressed intervocalic positions. Comparison of the results in different prosodic locations with the loanword adaptation patterns in those prosodic positions, thus, would clarify the influence of the P-map in the borrowing process.

One interesting observation on the results in intervocalic positions is that in most cases the Korean listeners perceived intervocalic voiced English stops as the Korean lax stops. English /b/ in word-initial position was perceived as /pʰ/ (46%) and /p/ (41%). However, 91% of the responses were lax /p/ for English /b/ in pre-stressed intervocalic position and lax /p/ consisted of 89% of the choices for English /b/ in post-stressed intervocalic position. The same patterns were observed in the case of English /d/. English /d/ in word-initial position was perceived as the Korean lax /t/ (85%) and tense /tʰ/ (14%). Yet, such tense responses disappeared in the answers for the English intervocalic stops. 95% and 83% of the responses for English /d/ in pre-stressed and post-stressed intervocalic positions, respectively, were the lax /t/.<sup>31</sup> (Table II and Table III in Appendix summarize the results.) These results are interesting for three reasons. First, the Koreans' changes in response depending on prosodic locations is limited to English voiced stops. Second, the perceptual shift is limited to lax and tense categories in Korean. Third, the stress in English does not seem to affect the P-map of the Korean listeners since there was very little difference in the Koreans' responses for pre- and post-stressed intervocalic stops. These perceptual results seem to reflect a Korean internal allophonic variation rule, i.e., the so-called intervocalic voicing rule (Ahn, 1998), which states that although Korean stops are phonemically voiceless, the lax stops are fully voiced in the intervocalic position. That is why some researchers argued that Koreans are more sensitive to the voicing contrast in the intervocalic position (Davis & Cho, 2006; Kang, 2003). If Koreans' P-map is different in word initial and intervocalic positions with respect to the timing of voice specification cross-linguistically, the previously proposed P-map constraint related to voicing contrast *BeSimilar[voice]* should be re-examined. According to the perceptual results for English intervocalic obstruents, therefore, I propose to modify *BeSimilar[voice]* as in (22).

(22) *BeSimilar[voice]*: Consonants in correspondence should be similar in voicing.

The correspondence of *BeSimilar[voice]* is:

- English voiced obstruents correspond to Korean tense and lax consonants. However, English voiced stops *in intervocalic positions* correspond to Korean lax consonants.
- English voiceless obstruents correspond to Korean aspirated consonants. However, [sʰ] instead of /sʰ/, corresponds to English voiceless consonants in perception of [voice].

The essence of *BeSimilar[voice]* is the same as being stated in (5c). However, the details for English voiced stops have been modified. English voiced stops in intervocalic

<sup>31</sup> Other than /t/ (83%) responses, /p/ responses consisted of 10% of the listeners' choices for English /d/.

positions only correspond to lax stops in Korean. Therefore, any tense stop candidates for English voiced stops in intervocalic positions will be violating *BeSimilar[voice]*. In fact, any tense stop candidates for English voiceless stops in intervocalic positions will also violate *BeSimilar[voice]*. This will predict that Korean tense stops never surface for English stops in intervocalic positions.<sup>32</sup> This prediction seems to be correct since there is no variation of Korean lax/tense stops for English voiced stops in intervocalic position. Further, it is also rare to borrow English intervocalic voiceless stops with Korean tense stops. The loanwords from English words having intervocalic stops are presented in (23).

(23)	a. /p/	apartment [a.p <sup>h</sup> a.t <sup>h</sup> i]	open [o.p <sup>h</sup> i n]
	b. /t/	item [a.i.t <sup>h</sup> em]	Utopia [yu.t <sup>h</sup> o.p <sup>h</sup> i.a]
	c. /b/	Abercrombie [e.pə.k <sup>h</sup> i.rom.pi]	e-bay [i.pe.i]
	d. /d/	Adidas [a.ti.ta.s <sup>h</sup> i]	deodorant [ti.o.to.ran.t <sup>h</sup> i]

## 7. Conclusions

The influence of perceptual factors in Korean loanword phonology or the P-map account has been examined in this paper. The cross-language perceptual category matching experiment with the orthographic classification technique was used to test the closet sound pairs between English and Korean sounds. Then, the perceptual results from Korean listeners were compared with actual Korean loanwords borrowed from English. The comparison suggests that the P-map is operating in Korean loanword phonology, while other non-perceptual factors such as *Ident(Place)* and *\*Cont* are also actively working simultaneously. Koreans' perception of English sounds could be misleading in that the Koreans perceived some English fricatives as Korean consonants at different places of articulation (e.g., English /v/ as Korean /t/, English /ð/ as Korean /p/, English /θ/ as Korean /p<sup>h</sup>/ or /p/). However, such a misleading P-map is never reflected in the borrowing of those English sounds in Korean, suggesting that the non-perceptual constraint *Ident(Place)* is active and undominated in Korean loanword phonology. However, the varied adaptation patterns of English voiced stops in Korean and the unified adaptation pattern for the same sounds in different prosodic locations seem to suggest that the P-map plays some role in Korean loanword phonology, since such differences were observed in the perceptual results from the Koreans listeners. In addition, the varied adaptation patterns for borrowing English fricatives could be well accounted for when we consider the flexible nature of perceptually motivated *BeSimilar* constraints in their ranking relationships and the interaction between *BeSimilar* constraints and the non-perceptual constraint *\*Cont* in the analysis.

Borrowing is a very complicated process involving perceptual, non-perceptual, phonological and morphological factors, as well as non-linguistic factors (e.g., historical reason, influence of orthography, frequency effect); thus it is difficult to give a unified explanation for all the loanwords even within one language. However, the P-map account

<sup>32</sup> According to the laryngeal view (Davis & Cho, 2006), it is unnecessary to consider different prosodic locations in the borrowing process; laryngeally unmarked English voiced stops will be borrowed with the laryngeally unmarked lax stops in Korean, whereas laryngeally marked English voiceless stops ([i.e. [spread glottis]]) will be borrowed with the Korean aspirated ones. The expansion of tense stops may contribute to the varied adaptation patterns of English stops in Korean loanwords (Shin & Davis, 2004).

can give a reasonable explanation for some parts of borrowing English obstruents in Korean. The varied adaptation patterns of English obstruents in Korean loanwords, in particular, illustrate the necessity of considering perceptual factors with our non-perceptual ones in Korean loanword phonology.

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## Appendix

Korean	English consonants									
	/p/	/b/	/f/	/v/	/t/	/d/	/s/	/z/	/θ/	/ð/
/p/		91	1	74						10
/pʰ/	2		17	3					7	
/pʰ/	89	1	66	6					6	
/t/		6		7		95				76
/tʰ/			3	1	1	3			24	
/tʰ/	3				96				1	
/L/				3						9
/s/							1		6	
/sʰ/			6	1			96		49	
/c/								99		1
/cʰ/								1		
/cʰ/										
/m/										
/h/	3		5	1					4	
Others				2						2

Table II. Matrix showing percentage labeling of English pre-stressed intervocalic consonants with Korean consonants. Judgments totaling less than 1% are not shown. Each stimulus had approximately 160 tokens (4 talkers × 40 listeners) for the analysis.

Korean	English consonants									
	/p/	/b/	/f/	/v/	/t/	/d/	/s/	/z/	/θ/	/ð/
/p/	17	87	18	82		10			6	28
/pʰ/	12		11	1					9	
/pʰ/	51		48	3					28	
/t/	2	5	3	4	5	81		4	3	66
/tʰ/	1		4		3	3			19	
/tʰ/	3		1		84				2	
/L/		3		6		3				2
/s/	1		3		1		17		2	
/sʰ/	5		8		1		73		28	
/c/					3		8	94		
/cʰ/							1			
/cʰ/										
/m/										
/h/	7	1	5			2			1	
Others	1	3		3						3

Table III. Matrix showing percentage labeling of English post-stressed intervocalic consonants with Korean consonants. Judgments totaling less than 1% are not shown. Each stimulus had approximately 160 tokens (4 talkers × 40 listeners) for the analysis.