Limits to the role of perception in Korean loanwords: English anterior obstruents in various prosodic locations

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1. Introduction

The role of perception has been widely debated among many linguists who study loanword phonology. One reason for such a debate comes from ample evidence for perceptual difficulties in the identification and discrimination of foreign sounds in cross-language speech perception and second language acquisition (e.g., Best, McRoberts, & Goodell, 2001; Ingram & Park, 1988; Singh & Black, 1966). Although the exact linkage between second language perception and production is not clear at this point, one apparent fact is that perceptually difficult sounds are also difficult to pronounce in a native-like fashion. For instance, most Korean and Japanese learners of English have difficulty in perceiving /r/ and /l/ as well as producing them correctly (e.g., Bradlow et al., 1997). We cannot overlook such interlanguage phenomena due to the similarity often found between interlanguage phonology and loanword phonology. The case of English /θ/ in Korean illustrates this point well. The English expression *thank you* is borrowed with either [**t'**eŋ.k^{h}yu] or [**s'**eŋ.k^{h}yu]; either the Korean tense stop [t'] or tense fricative [s'] is used in borrowing the English /θ/ into Korean. This alternation is not restricted to loanword phonology, but is also observed among Korean learners of English (e.g., Lee, 2006; Schmidt 1996). That must be one reason why the role of perception has been emphasized in the works of many phonologists such as Flemming (2004), Kang (2003b), Kenstowicz & Suchato (2006), Kim & Curtis (2002), Peperkamp & Dupoux (2003), Silverman (1992), and Steriade (2001) among others.

The P-map (i.e., Perceptual map) hypothesis developed by Steriade (2001) well summarizes the main idea underlying the works emphasizing the role of perceptual factors in the borrowing process. 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 or category inventory 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. A crucial point to keep in mind in understanding the debate over the role of perception is that perception in loanword phonology refers to *the perception of sub-phonemic properties*. 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 noticed that the absolute duration of the singleton [s] in English is always longer than [s] in the cluster, both word-initially and word-finally. Additionally, the Korean listeners were sensitive to the durational change of [s]. From these observations, it was concluded that the duration of the frication of /s/, plays a crucial role in the borrowing process, even though it is sub-phonemic property in both English and Korean. (See Davis & Cho, 2006 and Lee & Iverson, 2006 for different views on this issue.)

The works of LaCharité & Paradis (2002, 2005), on the other hand, emphasize the role of bilinguals rather than that of perception in the borrowing process. According to their view, bilinguals have complete access to both the source and recipient language phonologies; thus, sub-phonemic information is irrelevant and only phonemic or featural level matching between the sounds play an important role in loanword adaption. For example, English high lax vowels [ɪ] and [ʊ] are systematically adapted 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[1]. Therefore, LaChariaté & Paradis argue that the adaptation of English high lax vowels in Mexican Spanish is not determined by perceptual factors but is the phonemic category matching of the feature [+high].

Iverson & Lee (2006) 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 adaption only when it is salient in the recipient language. Their view is somewhat different from the perceptual approach because only sub-phonemic information in the source language, but not that in the recipient language, is relevant in the borrowing process. According to their view, therefore, Kim & Curtis (2002)'s study on the 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 Koreans.

In this paper, we examine Koreans' perceptual patterns of English sounds through a perceptual experiment to probe the influence of perceptual factors in loanword phonology. In the perceptual experiment, we asked Korean listeners to judge the similarity between English and Korean sounds; and 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. The comparison of the results with actual loanword adaptation patterns in Korean provides a good indication whether perception plays a role in loanword adaptation, and to what extent adaptation can be said to reflect borrowers' perception.

The remainder of this paper has the following structure: Section 2 reports how the perceptual experiment was conducted in order to find the most similar Korean categories to English anterior stops and fricatives. In Section 3, the

results from the experiment are given and Koreans' perceptual patterns are compared with their loanword adaptation patterns. Then, Section 4 concludes the paper after discussing the role of perception in the borrowing process.

2. Experiment

2.1. Talker and Stimuli

Four native speakers of American English (two male and two female) produced the stimuli for the experiment. All of them were in their late 20's and had a residential history dominated by the Northern Mid-west. The speakers 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 four prosodic locations: onset, pre-stressed intervocalic, post-stressed intervocalic, and coda positions (e.g., /pa/, /ápa/, /apá/, /ap/, etc.). 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 MIKII DAT recorder at a sampling rate of 44.1kHz. The recordings were then transferred from DAT to a G4 Macintosh computer in the Linguistic Speech Lab at Indiana University for editing.

2.2. Listeners

Forty native Korean undergraduate students (28 females and 12 males) participated in this experiment. Although they had studied English as a regular course in school for 7 years or more, none had lived in an English speaking country prior to the experiment. Most listeners were from Seoul or Kyeonggi areas and were in their 20's (mean = 24.97 yrs). All the participants were paid for their participation in the study.

2.3. Procedures

In order to find the most similar pair of sounds in the source and the

recipient languages, an orthographic classification technique was used. This technique asks participants to use a phonemic native orthographic system for the response label, so that non-native categories can be tapped into the native categories (see Park & de Jong, 2007, for further details). In the current study, the listeners were asked to choose the consonant they heard from 13 alternatives presented in Korean orthography. The listeners were also provided the option of writing-in a response (Other: ___) for cases where the listeners could not find any matching consonant in the pre-selected alternatives. The choices are given in (1) with the translation.

(1) ㅂ ㅃ ㅍ ㄷ ㄸ ㅌ ㅅ ㅆ ㅈ ㅉ ㅊ ㄹ ㅎ 그 외 ( )
p p' p^h t t' t^h s s' c c' c^h l h others

The listeners were told that the stimuli were not real English words. Since the Korean orthography is a phonemic system, there was no apparent difficulty in using the Korean alphabet for the choices. In order to avoid any misunderstanding of the experimental procedure, five practice items were played before each task. The stimuli were played from a CD by means of either a PC or a playback device through loudspeakers. The experiment was run in groups of approximately 10, and was conducted in a quiet room in a university located in Korea.

3. Koreans' perception patterns of English obstruents and their adaptation patterns[2]

3.1. Word-initial onset position

The experimental results from the word-initial onset position (henceforth, onset position) are summarized in Table I. Three perceptual patterns can be recognized from Table I. First, most Korean listeners agreed on the choice of Korean consonant for English consonants /p/, /t/, /s/, and /z/. The Korean listeners chose /p^h/ (95%), /t^h/ (98%), /s'/ (89%), and /c/ (95%) for English /p/,

	English consonants									
Korean	/p/	/b/	/f/	/v/	/t/	/d/	/s/	/z/	/θ/	/ð/
/p/		41	8	65			1			15
/p'/		46	23						7	
/p^h/	95	8	54						16	1
/t/		1		18		84		2	7	78
/t'/						14	1		24	1
/t^h/	1				98					
/L/				6						
/s/							2		4	
/s'/			4	2			89		40	
/c/					1		6	95		
/c'/							2	3		
/c^h/										
/m/										
/h/	1	2	5	1						1
Others		2	4	5						2

Table I. Matrix showing the percentage labeling of English word-initial onset 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.

/t/, /s/, and /z/, respectively. One thing to notice here is that Koreans' choices for these English sounds agree in place of articulation in general. The second pattern observed from Table I is that Koreans' judgments on English /b/, /d/, /ð/, /v/, and /f/ were divided between two Korean sounds. In this pattern, we can also see the place of articulation matching between Korean and English consonants. For example, for English labial stop /b/, the listeners chose Korean labial tense and lax stops /p'/ (46%) and /p/ (41%). Such a lax/tense division with the matching place of articulation is shown in the judgment of English coronal stop /d/; 84% of the choices were Korean coronal lax stop /t/ and 14% were coronal tense stop /t'/. In addition, Korean labial stops /p^h/ (54%) and /p'/ (23%) were chosen for English labial fricative /f/. However, Koreans' choices for English voiced fricatives included Korean consonants with the mismatching place of articulation to the English fricatives. For instance, though the Korean coronal stop /t/ was selected at a rate of 79% for English non-sibilant coronal fricative /ð/, the Korean labial stop /p/ was also selected at a rate of 15%. The listeners also chose the Korean coronal stop /t/ at a rate of 18% and the Korean labial stop

/p/ at 65% for English labial fricative /v/. The third pattern in word-initial onset position is that Koreans' different choices for English /θ/ were numerous. For example, the Korean listeners chose Korean /s'/ (40%), /t'/ (24%), and /p^h/ (16%) for English /θ/.

The purpose of this perceptual experiment is to investigate to what extent perceptual patterns are reflected in adaptation patterns. First, some English onset consonants are borrowed with one Korean consonant as in (2a) to (4). For example, English /p/ and /t/ in onset are always borrowed with Korean aspirated [p^h] and [t^h] as in (2a) and (2b). English singleton /s/ in onset is uniformly borrowed with Korean tense [s'] as in (2c) and English /z/ with Korean [c] as in (2d). The uniform adaptation pattern for these English sounds agrees with the perceptual patterns, since the most Korean listeners agreed on the choice of Korean consonants for these English sounds.

(3a) and (3b) also present other English sounds /v/ and /ð/, which are uniformly borrowed into Korean: Korean lax [p] for English /v/ and Korean lax [t] for English /ð/ in onset position. Recall that Korean listeners chose lax /p/ along with lax /t/ for English /ð/, and also selected lax /t/ as well as lax /p/ for English /v/. However, Korean lax /p/ and English /ð/ do not match in place of articulation and neither do Korean lax /t/ and English /v/. Therefore, *if we ignore Koreans' perceptual patterns mismatching in place of articulation with the English consonant,* the perceptual patterns seem to agree with the adaptation patterns.

In general, this relationship between perceptual and adaptation patterns holds true for most cases in onset position. For instance, English voiced stops /b/ and /d/ in onset position are borrowed with Korean tense or lax stops with corresponding place of articulation as in (5a) through (5d). Interestingly, these varied adaptation patterns agree with Koreans' perceptual patterns for these sounds. English /θ/ is also borrowed with two Korean consonants, [t'] or [s'] as

in (6). For English /θ/, Korean listeners chose /t'/, /s'/ and /p^h/ in the perceptual experiment (Table I). Therefore, if we ignore /p^h/ responses due to the place-mismatching between /p^h/ and /θ/, we can predict the right varied adaptation patterns for English /θ/. Despite the successful match between perceptual and adaptation patterns for most cases, perceptual patterns cannot account the case for English /f/ adaptation. English /f/ in onset position was perceived as Korean labial stops /p^h/ (54%) and /p'/ (23%). Although both choices match in place of articulation to that of English /f/, English /f/ is always borrowed with /p^h/ as in (4).[3]

(2)	a. /p/	*pen*	[**p^h**en]	*pad*	[**p^h**e.tɨ]
	b. /t/	*tomato*	[**t^h**o.ma. t^{h}o]	*toll gate*	[**t^h**ol.ke.ɨ.t^{h}ɨ]
	c. /s/	*siren*	[**s'**a.i.ren]	*sign*	[**s'**a.in]
	d. /z/	*zero*	[**c**e.ro]	*zipper*	[**c**i.p^{h}ə]
(3)	a. /v/	*van*	[**p**en]	*valve*	[**p**el.pɨ]
	b. /ð/	*this*	[**t**i.s'ɨ]	*that*	[**t**et]
(4)	/f/	*fax*	[**p^h**ek.s'ɨ]	*form*	[**p^h**om]
(5)	a. /b/	*badge*	[**p'**e.c'i]	*bar*	[**p'**a]
	b. /b/	*biscuit*	[**p**i.sɨ.ket]	*button*	[**p**ə.t^{h}ɨn]
	c. /d/	*dance*	[**t'**en.s'ɨ]	*dollar*	[**t'**al.lə] or [**t'**al.la]
	d. /d/	*dilemma*	[**t**il.le.ma]	*dogma*	[**t**o.gɨ.ma]
(6)	/θ/	*thank you*	[**t'**eŋ.k^{h}yu] or [**s'**eŋ.k^{h}yu]		
		think	[**t'**in.k^{h}ɨ] or [**s'**in.k^{h}ɨ]		

3.2. Intervocalic positions

Tables II & III summarize the Koreans' perceptual patterns in pre-stressed intervocalic and post-stressed intervocalic positions, respectively. One apparent observation from these results is that perceptual patterns for some segments in intervocalic positions are not the same as those in word-initial onset position. For example, English /b/ and /d/ were perceived as Korean tense or lax consonants in onset position (Table I). However, such divided judgments were not observed for those English segments in pre-stressed intervocalic position

	English consonants									
Korean	/p/	/b/	/f/	/v/	/t/	/d/	/s/	/z/	/θ/	/ð/
/p/		91	1	74						10
/p’/	2		17	3					7	
/p^h/	89	1	66	6					6	
/t/		6		7		95				76
/t’/			3	1	1	3			24	
/t^h/	3				96				1	
/L/				3						9
/s/							1		6	
/s’/			6	1			96		49	
/c/								99		1
/c’/								1		
/c^h/										
/m/										
/h/	3		5	1					4	
Others				2						2

Table II. Matrix showing the 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.

	English consonants									
Korean	/p/	/b/	/f/	/v/	/t/	/d/	/s/	/z/	/θ/	/ð/
/p/	17	87	18	82		10			6	28
/p’/	12		11	1					9	
/p^h/	51		48	3					28	
/t/	2	5	3	4	5	81		4	3	66
/t’/	1		4		3	3			19	
/t^h/	3		1		84				2	
/L/		3		6		3				2
/s/	1		3		1		17		2	
/s’/	5		8		1		73		28	
/c/					3		8	94		
/c’/							1			
/c^h/										
/m/										
/h/	7	1	5			2			1	
Others	1	3		3						3

Table III. Matrix showing the 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.

(Table II); 91% of the choices for English /b/ were Korean lax /p/ and 95% for English /d/ were Korean lax /t/. Interestingly, these unified perception patterns for English voiced stops /b/ and /d/ seem to agree with the actual adaptation patterns. Although English /b/ and /d/ in onset position are borrowed with tense

or lax stops as in (5a) to (5d), these are always borrowed with lax stops [p] and [t], respectively, in intervocalic position as in (7a) and (7b).

(7) a. /b/ *Abercrombie* [e.**p**ə.k^{h}ɨ.rom.pi] *e-bay* [i.**p**e.i]
b. /d/*Adidas* [a.**t**i.**t**a.s'ɨ] *deodorant* [te.o.**t**o.ran.t^{h}ɨ]

Again, however, perceptual patterns are not always reflected in adaptation patterns. For instance, English /p/ was perceived as three Korean labial categories /p^{h}/ (51%), /p/ (17%) and /p'/ (12%) in post-stressed intervocalic position (Table III), while it was perceived as /p^{h}/ most of the time in onset and pre-stressed intervocalic positions (Table I & II). These perceptual patterns which depend on prosodic location, however, are not reflected in the adaptation pattern of English /p/; English /p/ is always borrowed with aspirated [p^{h}], regardless of its prosodic location as in (8a) through (8c).

(8) a. /p/ in onset position: *Paul* [**p^{h}**ol**]**
b. /p/ in pre-stressed intervocalic position: *appeal* [ə.**p^{h}**il]
c. /p/ in post-stressed intervocalic position: *open* [o.**p^{h}**ɨn]

3.3. Coda position

Table IV summarizes the perceptual experiment results in coda position. The results in Table IV clearly demonstrate a coda neutralization influence in Koreans' perception. Laryngeal and manner distinctions are neutralized in Korean codas. This may have caused Korean listeners' judgment on English coda segments to vary, resulting in a large proportion of "Others" responses. Also since all coda consonants are unreleased in Korean, the proportions for /h/ responses are greater in coda position compared to those in other prosodic locations; it is possible that the release of English coda segments was perceived as Korean /h/.

In addition to the coda neutralization influence, the influence of a Korean native morphophonemic restriction on coda /t/ is also observed. In modern Korean nouns, lexical /s/ is dominant in coda position, whereas lexical /t/ is rare

	English consonants									
Korean	/p/	/b/	/f/	/v/	/t/	/d/	/s/	/z/	/θ/	/ð/
/p/	31	49	8	51	3	11			4	31
/p'/									3	
/p^h/	24	6	62	11		2	1		32	9
/t/		6	1	3	2	41				7
/t'/					3	3			3	
/t^h/	3	1		3	73	9			3	2
/L/	1	4		4		4				19
/s/	8	6	6	4	11	16	34	26	11	4
/s'/	1	1	4		3	1	63	11	25	3
/c/								62		
/c'/										
/c^h/										
/m/										
/h/	8	12	13	15	3	3			13	15
Others	23	14	4	8	1	11			4	10

Table IV. Matrix showing the percentage labeling of English coda 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.

(Sohn, 2001). This morphophonemic restriction may cause English words ending with coronal stops /t/ and /d/ to be adapted with Korean /s/ (Davis & Kang, 2003; Kang, 2003a). In Korean, all coronal obstruents become [t] in coda position, so that the identity of coronal obstruents becomes difficult to recognize as an independent form. However, the identity is revealed when a vowel follows the coronal obstruent, because it is resyllabified to the onset (i.e., non-coda) position of the following syllable where coda neutralization no longer has an influence (c.f., see Kang, 2002, for further details). Examples are given in (9); although English coda /t/ and /d/ are adapted as Korean [t] as an independent form, they are realized as Korean /s/ when the vowel suffix /i/ follows.

(9) English	Independent form	before the vowel suffix /i/
internet	[in.t^hə.ne**t**]	[in.t^hə.ne**s**i]
David	[te.i.pi**t**]	[te.i.pi.**s**i]

An interesting observation in perception patterns is that Korean listeners chose Korean lax /s/ for English coronal stops /t/ and /d/ in coda position at a rate of 11% and 16%, respectively. Considering that the current experiment was

purely perceptual (i.e., identification of consonants that listeners perceived), and also that Korean /s/ is not similar to English stops /t/ and /d/, either acoustically and phonetically, these /s/ responses are striking. Studies of perceptual confusions in other languages (e.g., Silbert & de Jong, 2007) always find sibilant /s/ to be very perceptually distinct from stops. Lastly, the large proportion of Korean lax /s/ responses (34%) for English coda /s/ should be noticed because singleton English /s/ in coda position is always adapted as Korean tense [s'] rather than lax [s]. Examples are given in (10).

(10) /s/ *bus* [pə.**s'** i] *Ace* [e.i.**s'** i]

4. Discussion and Conclusion

The current study has shown that a large proportion of adaptation patterns agree with native listeners' perception. It is especially noticeable that varied adaptations of some English sounds agree with the listeners' perception of those segments. For example, Korean listeners' perceptual responses for English word-initial onset stops /b/ and /d/ were divided between Korean tense or lax stops with matching place of articulation to the English stops. Adaptation patterns of these sounds seem to well reflect these divided perceptual patterns. Moreover, these divided perceptual responses disappeared in the pre-stressed intervocalic position, and this uniform perception of English voiced stops also agrees with the actual adaptation patterns.

Nevertheless, it is important to remember that native perceptual patterns are not as uniform as adaptation patterns. Perceptual identification often involves many low probability results for each segment, while only the higher probability responses are reflected in adaptation patterns. Also Korean listeners often chose Korean consonants with mismatching place of articulation to English sounds. However, there is no single adaptation pattern that reflects such perceptual patterns. This suggests that the borrowing process is doing more than

just matching perceptual patterns between sounds in the source and the recipient languages. Rather, this process seems to involve high-level grammatical generalizations, such as morphophonemic restrictions and native phonological processes, resulting in a systematic adaptation of foreign sounds. The Koreans' responses for English coronal stops /t/ and /d/ well illustrate that even perception is not free from the operative high-level grammar. All things considered, therefore, the point is clear: the borrowing process is, though clearly related to it, more than sub-phonemic perception.

Notes

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1. Note, however, that acoustic similarity does not necessarily lead to perceptual similarity.
2. The experimental results were partly presented in Park (2007) under the Optimality Theoretical framework.
3. There are cases where /f/ is borrowed with /h/. For example, English word *fresh* is borrowed as either [**p**$^{\mathbf{h}}$u.re.ši] or [**h**u.re.ši]. However, these cases are not from English but from Japanese, as argued by Lee & Cho (2006). See also Kang, 2007, on loanword adaptation from a diachronic perspective.

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