

# Tensification of voiced stops in English loanwords in Korean

Yoonjung Kang

University of Toronto Scarborough

## 1 Introduction

English voiced stops and affricate<sup>1</sup> /b d g dʒ/ are usually realized as a lax consonant /p t k c/ when borrowed into Korean. But, in word-initial prevocalic position these consonants are realized as a tense stop /p\* t\* k\* c\*/ in certain words as shown in (1a). Such variation is lexically restricted such that tense consonant adaptation is found only in certain words and unavailable for others as shown in (1b)

- (1) a. **h**onus → /p\*onʌs\*i/  
**d**ollar → /t\*alla/  
**[dʒ]**elly → /c\*elli/  
**g**as → /k\*as\*i/  
b. **h**elt → /pelt<sup>h</sup>i/, \*/p\*elt<sup>h</sup>i/  
**d**isk → /tisik<sup>h</sup>i/, \*/t\*isik<sup>h</sup>i/  
**[dʒ]**ournal → /cʌnʌl/, \*/c\*ʌnʌl/  
**g**uide → /kaiti/, \*/k\*ait<sup>h</sup>i/

In this paper, I propose that words like (1a) tend to be older borrowings from the early 20<sup>th</sup> century when the Korean tense stops were the phonetically closest match for word-initial voiced stops of English and that subsequent changes in the phonetic structure of Korean laryngeal contrast over the last several decades and the establishment of normative orthographic convention for loanwords shifted the preferred choice of adaptation for English voiced stops in word-initial position to a lax stop of Korean. As a result, in Present Day Korean (PDK), the tense pronunciation of initial English stops tends to be preserved in frequently used loanwords which managed to retain the older pronunciation with a tense stop due to their high frequency of occurrence against the general pressure of regularization to lax stops.

The paper is organized as following. Section 2 will discuss the distribution of tense stop adaptation in PDK and Section 3 will review the previous accounts of the phenomenon. Section 4 will discuss the distribution of tense stop adaptation of English

voiced stops in the early 20<sup>th</sup> century Korean based on S. Kim (2003)'s study of *Modern Chosun Loanword Dictionary* (1937). Section 5 will propose a comprehensive account of the tense stop adaptation of English word-initial voiced stops by taking into account the phonetics of English and Korean stops and ongoing changes in phonetic structure of laryngeal contrast in Korean as well as the establishment of and changes in the transcription convention of foreign words in Korean over the last several decades. Section 6 concludes the paper.

## 2 Tense stops in English loans in Present Day Korean (PDK)

Oh (2004) observes that English voiced stops are realized as a tense stop of Korean only when the stop is word-initial and prevocalic. When the English voiced stop is not word-initial as in (2a), or is part of a consonant cluster as in (2b), it is not consistently adapted as a lax stop.<sup>ii</sup>

- (2) a. double → /t\*ʌpɪl/, \*t\*ʌp\*ɪl/<sup>iii</sup>  
      board → /p\*otɪ/, \*p\*ot\*i/  
      b. drama → /tirama/, \*t\*irama/  
      black → /pillæk/, \*p\*illæk/

In the current study, to understand the extent of tensification in word-initial prevocalic position in PDK quantitatively, I examined the loans that contain word-initial prevocalic stops of English in the word list compiled by the National Academy of the Korean Language (NAKL 2002). The data in this source generally follow the orthographic guideline that prohibits the use of tense letters for English stops (The Ministry of Education 1985) and the actual pronunciation of the initial stops is not reflected. Therefore, I marked each word in the list according to whether a tense pronunciation is available or not in my own speech. Also, I conducted a similar examination based on the NAKL loanword list from 1990 (NAKL 1991). A couple of notable generalizations emerge.

First, the proportion of words showing tense adaptation is around 20%, which is substantial but is not the majority pattern, as shown in the table in (3). A similar proportion of tense stop adaptation of word-initial /g/ is reported in Yeo (1985) based on Pae (1981): 17% (42 out of 247). Among stops of different places of articulation, /d/ shows the lowest rate of tense adaptation compared to /b/ or /g/.

- (3) The proportion of English loanwords with word-initial prevocalic voiced stops that are realized with a tense stop in Korean

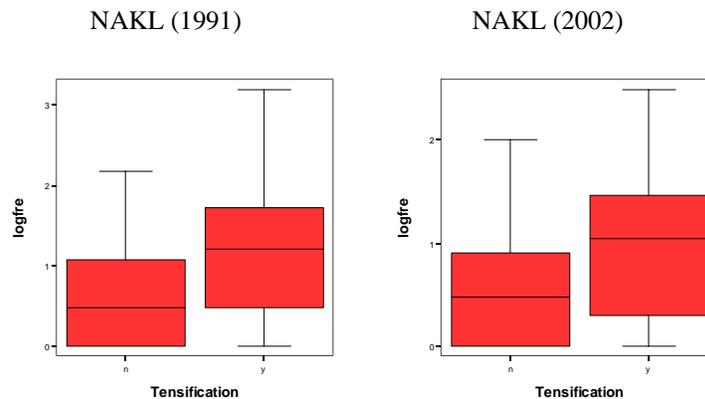
Initial stop	NAKL (1991)		NAKL (2002)	
	N	Tense adaptation	N	Tense adaptation
/b/	141	25 (17.7%)	122	26 (21.3%)
/d/	98	8 (8.2%)	71	8 (11.3%)
/g/	47	10 (21.3%)	34	8 (23.5%)
/dʒ/	24	7 (29.2%)	36	7 (19.4%)
Total	310	<b>50 (16.1%)</b>	263	<b>49 (18.6%)</b>

Secondly, both NAKL (1991) and NAKL (2002) contain frequency counts of each word from the corpora from which the lists were created. This allows us to examine if the words showing tense adaptation have different frequency characteristics from those showing lax adaptation. Many of the words showing tense adaptation are very commonly used words and have a higher average frequency than those words showing lax adaptation ( $p < 0.001$  in both lists from NAKL 1991 and NAKL 2002) as summarized in the table in (4). The boxplots in (5) illustrate the difference in the range of frequency of occurrence between loans with tense adaptation vs. those with lax adaptation.

- (4) Average frequency of occurrences for loans with tense vs. lax adaptation of English word-initial prevocalic voiced stops

Adaptation of voiced stops	NAKL (1991)		NAKL (2002)	
	N	Average frequency of occurrence (SD)	N	Average frequency of occurrence (SD)
Lax	260	12.98 (23.38)	214	7.74 (11.68)
Tense	50	102.80 (258.77)	49	40.29 (80.44)
Total	310	27.47 (110.32)	263	13.80 (38.18)

- (5) Boxplots showing the frequency distribution of words with lax ('n') vs. tense adaptation ('y') of English word-initial pre-vocalic voiced stops



To summarize, the tense adaptation of word-initial prevocalic voiced stops of English is found only in about 20% of the relevant loanwords in PDK. The distribution of tense adaptation is lexically restricted and tends to be found in words of high frequency of use. Also noted is the place of articulation asymmetry—namely, /d/ is realized as a tense stop at a lower rate than /b/ or /g/.

### 3 Previous accounts

In the literature, there are three types of explanations put forth for the tense stop realization of English voiced stops in words like those shown in (1a); (i) the tense adaptation is a Japanese influence (mentioned in passing in M.-J. Lee 1993, Kwon 1995); (ii) the tense realization is due to a general sound change in Korean whereby word-initial lax stops are tensified (Yeo 1985, Shin and Davis 2004, Oh 2004); (iii) Tense consonants are the appropriate match for the English voiced stops in terms of phonetic similarity (Pae 1967 mentioned in Yeo 1985; Kim-Renaud 1974; S. Lee 1981). The current paper essentially argues for the third position but with the qualification that a deeper understanding of the phenomenon is possible when one takes into account a change in sound structure of Korean over the last several decades and the influence of normative orthographic convention. In this section, I will provide arguments against the first two accounts.

The Japanese influence account is not supported by the pattern of adaptation in Japanese loanwords in Korean. Ito et al (2006)'s study of Japanese loanwords in Korean shows that Japanese voiced stops are consistently adapted as lax stops of Korean (J.

/dai/ → K. /tai/ ‘table’; J. /gara/ → /kara/ ‘pattern’; /bento/ → /pent\*oo/ ‘lunch box’). Therefore, English voiced stops that are borrowed into Japanese (which are realized as voiced stops of Japanese) that are in turn borrowed into Korean are expected to be realized as lax stops, not as tense stops. Another possible interpretation of the Japanese influence account is that the tense realization of voiced stops is due to the general prevalence of tense stops in loanwords from Japanese. Indeed, voiceless obstruents of Japanese are realized as tense obstruents in Korean borrowings in many cases (Ito et al 2006). If this hypothesis is indeed correct, we would expect the voiced-to-tense adaptation to be found at a higher rate in words that contain other characteristics of Japanese influence than those that do not show other characteristics of Japanese influence. However, a quantitative examination of correlation of voiced-to-tense adaptation and other Japanese characteristics in a list of Japanese-style English loanwords (Kang et al. 2007) do not show any such correlation ( $p = 0.88$ ). In other words, words like (1a) do not have more characteristics of Japanese influence than words like (1b).

The second account—namely, the tense realization is due to a general sound change in Korean whereby word-initial lax stops are tensified—does not seem viable, either. Before we go into the arguments against this second hypothesis, some background discussion on the word-initial tensification in Korean is in order.

In PDK, many words that have a word-initial obstruent historically are variably pronounced with a tense obstruent, as the examples in (6) illustrate. This change is mostly affecting native words (6a) but some Sino-Korean words are affected as well (6b) (Park 2000). This change is a continuation of the historical change from Middle Korean whereby some words with an initial lax stop have completely changed over to tense stop-initial words as shown in (6c) (Heo 1965, K. M. Lee 1972). Moreover, in many southern dialects, the change has progressed further than in the standard dialect as shown in (6d) (T. Y. Choi 1983, K. Y. Lee 1996, 2000). Sociolinguistic studies show that tensification is more frequently found in the speech of younger generation than in that of older generation (M. J. Lee 1989, Y. G. Kim 2004).

- (6) a. Tensification in Native words  
/kupta/ ~ /k\*upta/            ‘to grill’  
/tak\*ta/ ~ /t\*ak\*ta/           ‘to scrub’  
/pok\*ta/ ~ /p\*ok\*ta/           ‘to stir fry’
- b. Tensification in Sino-Korean words  
/komul/ ~ /k\*omul/            ‘junk’  
/pon(t\*ita)/ ~ /p\*on(t\*ita)/    ‘to copy’  
/sæŋ (mʌli)/ ~ /s\*æŋ (mʌli)/   ‘straight hair’

- c. Changes from Early Middle Korean
  - /koc/ > /k\*oc<sup>h</sup>/ 'flower'
  - /pulhwi/ > /p\*uli/ 'root'
  - /kit<sup>h</sup>/ > /k\*it<sup>h</sup>/ 'end'
- d. Tensification in Cenla and Kyengsang dialects
  - /kalc<sup>hi</sup>/ > /k\*alc<sup>hi</sup>/ 'cutlass fish'
  - /tok\*epi/ > /t\*ok\*epi/ 'a goblin'
  - /pʌnkæ/ > /p\*ʌnkæ/ 'lightning'

The tensification in native and Sino-Korean words, however, differs from the tensification in English loanwords under discussion in several crucial respects, casting a serious doubt on the claim that the two tensification processes are cut from the same cloth. First, as we will see in the next section, the rate of tensification in English loanwords has declined significantly from the 1930's to PDK (around 80% → 20%). This is in contrast to the tensification in native and Sino-Korean words, which is on the increase. Secondly, although the much-discussed cases of tensification in native and Sino-Korean may give the impression that initial tensification is rampant in PDK, the actual statistics show that the percentage of lax-stop initial words affected by tensification is fairly low in the native and Sino-Korean vocabulary. According to Park (2000), only 4.0% of Native Korean words with word-initial lax stops show consistent tensification in the standard dialect. The rate is even lower for Sino-Korean words, at 0.2%.<sup>iv</sup> Thirdly, tensification in native and Sino-Korean words generally adds a semantic flavor such as emphasis (/cinhata/ ~ /c\*inhata/ 'dark, thick') or pejorative connotation (/casik/ 'offspring' vs. /c\*asik/ 'son of a gun', /callita/ 'to be cut' vs. /c\*allita/ 'to be expelled, fired') (Park 2000). But, tensification in English loanwords does not carry such semantic effect.

To summarize, this section provides arguments against two previous accounts of tense adaptation of English voiced stops in words like (1a). Namely, the tensification in English loans cannot be attributed to a Japanese influence or a Korean-general sound change of word-initial tensification. Now, I turn to the tense adaptation of English voiced stops in loanwords in the 1930's before I present my account in Section 6.

## 5 Tense stop adaptation of word-initial English voiced stops in Korean in the 1930's

Our data for this section come from Lee Jong-Keuk's *Modern Chosun Loanword dictionary* (1937). See Kang (in preparation) for a more extensive study of laryngeal adaptation of stops in loanwords in *Modern Chosun Loanword Dictionary* (1937). According to S.H. Kim (2003), the pattern of

adaptation of voiced stops in word-initial and word-medial position in the dictionary is as following.

(7) Adaptation of English voiced stops in *Modern Chosun Loanword Dictionary* (1937) based on S. H. Kim (2003)

Stop	Word-initial voiced stops				Word-medial voiced stops			
	N	Tense	Lax	Tense ~ Lax	N	Tense	Lax	Tense ~ Lax
/b/	194	62.9%	17.5%	19.6%	100	3%	96%	1%
/d/	178	51.6%	24.2%	24.2%	154	1.9%	98.1%	0%
/g/	118	57.6%	21.2%	21.2%	95	0%	100%	0%
Total	490	<b>57.6%</b>	20.8%	21.6%	349	<b>1.7%</b>	98%	0.3 %

Several significant observations can be made. First, the word-initial stops are adapted as tense stops of Korean in the majority of cases (about 80%, if variable adaptations are also included) and this is in contrast with the relatively low rate of tense adaptation (around 20%) found in PDK. Secondly, in the 1930's loans, the adaptation of voiced stops is much more variably with about 20% of the word-initial voiced stops showing both tense and lax adaptation possibilities. In particular it is notable that the adaptation of a single phoneme is not uniform across different segmental contexts; in the word-initial position, the majority pattern is adaptation to a tense stop; on the other hand, the lax stop is the consistent choice in word-medial position. Thirdly, similar to the PDK data, /d/ shows the lowest rate of tense adaptation compared to /b/ or /g/, although the difference does not reach statistical significance. Finally, in the 1930's, tense adaptation of initial voiced stop is found not only in prevocalic stops as in (8a) but also in preconsonantal stops as in (8b), the latter of which is not found in PDK as shown in (2b) (Oh 2004).

- (8) a. **ballon** → /p\*allun/ ~ /palun/  
**doubt** → /t\*aut<sup>h</sup>i/  
**guy** → /k\*ai/  
b. **blue** → /p\*ullju/ ~ /pullu/  
**drug** → /t\*ilΛk/  
**grand** → /k\*ilæ̃n(ti)/ ~ /kulæ̃nti/

Some questions arise from the comparison of word-initial voiced stop adaptation in the 1930's data and the PDK data. (i) Why is the rate of tense adaptation much higher in the 1930's data than in the PDK data? (ii) Why is the adaptation pattern so much more variable in the 1930's data than in the PDK data? (iii) Why do the pre-consonantal voiced

stops show different adaptation pattern in the 1930's data (8b) and the PDK data (2b)? In the next section, I will propose a comprehensive account of the facts discussed so far that will address these questions.

## 5 Proposal

As mentioned in section 3, some previous studies proposed that the tense stop adaptation of word-initial voiced stops in English loanwords is based on phonetic similarity (Pae 1967 mentioned in Yeo 1985; Kim-Renaud 1974; S. Lee 1981). While Pae 1967 and Lee 1981 proposed that the tense stops are the best match for the English voiced stops phonetically, Kim-Renaud (1974) proposed that the variability in adaptation is a reflection of the indeterminacy in the phonetic matching. Park (this volume)'s study provides a confirmation of such indeterminacy in perceptual matching. When asked to match English word-initial prevocalic stops 'b' and 'd' in [ \_a ] context, Korean speakers chose to map them to Korean lax stops in the majority of cases but tense stops were selected at a substantial rate (41% for /b/ and 14% for /d/).

The observed variability in perception makes sense if we consider the acoustic properties of English voiced stops and Korean lax and tense stops in word-initial position (See Cho et al 2002 for a recent comprehensive review of acoustic properties of the laryngeal contrast in Korean obstruents). English voiced stops are characterized by a low VOT value. Based on the VOT values alone, Korean tense stops, which have the lowest VOT value among the three stop categories of Korean, are expected to be the best match for English voiced stops (cf. Lisker and Abramson 1967). For Korean lax vs. tense contrast, however, the cues from the following vowel such as F0, breathiness and the quality of vowel onset are also very important, likely more so than the VOT cue (Kim et al. 2002 and other references cited therein). If we examine the vocalic cues from the vowel following word-initial voiced stops of English, Korean lax stops are a better match for English voiced stops than Korean tense stops. In line with the cross-linguistic tendency, in English, vowels exhibit a lower F0 value following a voiced obstruent than following a voiceless obstruent (Hombert et al 1979, Ishihara 1998). The F0 tracks from Ishihara (1998) replicated in (9) illustrate this point.

In other words, the VOT cue and the vocalic cue from English word-initial voiced stops provide conflicting information for Korean speakers as they try to map them to a single laryngeal category in Korean; while the VOT cue prefers the tense stop adaptation, the vocalic cue prefers the lax stop adaptation. Therefore, it is understandable that Korean speakers' perception of English voiced stops shows a variation.

(9) F0 perturbation of vowels following word-initial /t/ vs. /d/ in two English speakers' utterances (Ishiraha 1998)

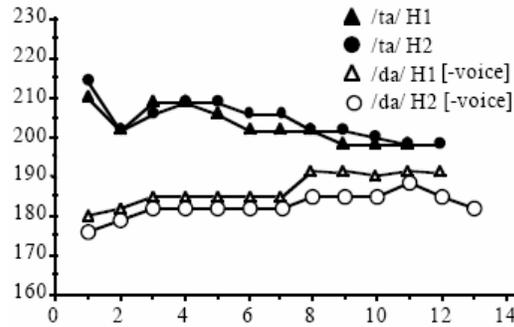


Figure 4: F0 perturbation of /tɑ/ (H) and /dɑ/ (H) (Speaker FM1)

It is also interesting that there is a striking difference between the rate of tense stop response for /b/ (41%) and /d/ (14%) in Park's perception study. Even more interesting is the fact that the difference is mirrored in the rates of tense stop adaptation in English loans. In the 1930's data summarized in (7), the rates of tense adaptation for /b/ vs. /d/ are 82.5% and 75.8%, respectively and in the NAKL (1991, 2002) data summarized in (3), the rates of tense adaptation are 17.7% and 21.3% for /b/ and 8.2% and 11.3% for /d/, respectively. I will leave the cause of such place of articulation effect in tense stop perception for a future research. Regardless of the cause for the difference observed for /b/ and /d/ in perception, it is notable that the place of articulation effect found in perception is mirrored in the loanword data.

The consistent adaptation of word-medial voiced stops as lax stops of Korean is also mirrored in Park's perception study. In word-medial position, there are other phonetic cues (such as the length of the stop closure and voicing of the lax stops in Korean) that make the lax stops of Korean an unambiguous match for the voiced stops of Korean.

Park's study provides evidence that Korean speakers' perception of English word-initial voiced stops is variable between lax and tense stops and that perceptual similarity may be the underlying cause for the tense stop adaptation in words like (1a). But, notice that the rates of tense stop response in the perception study are overall much higher (14 ~ 40%) than the corresponding rates found in PDK loanwords (8.2 ~ 21.3%) and at the same time much lower than the corresponding rates found in the 1930's loanwords (82.5 ~ 75.8%).

Then what has changed from the 1930's to PDK and what makes the tense adaptation rate in PDK further lower than the perception-based mapping would predict? I propose that the answers to these questions lie in two key changes that occurred in the period between the 1930's and PDK. First, as Silva (2006) noted, the phonetic structure of Korean laryngeal contrast has undergone

a significant change over the last several decades. Concentrating on the lax vs. aspirated contrast, Silva demonstrates that the laryngeal contrast of Korean has changed from one of VOT to one of vowel quality and F0. In other words, Korean is undergoing a process of Tonogenesis whereby the laryngeal contrast of consonants gives rise to and is eventually replaced by a tonal contrast on a neighboring vowel. If there indeed was such a restructuring in the phonetic properties of laryngeal contrast in Korean, it makes sense that given an English voiced stop, the Korean speakers of the 1930's put a more weight to the consonantal characteristics (i.e., low VOT) in deciding a mapping to a Korean category matching them to tense stops predominantly, while the Korean speakers of later decades put an increasingly more weight to the vocalic quality (i.e., low F0), increasing the likelihood of perceiving the same sounds as lax stops.

The fact that the pre-consonantal voiced stops, which are realized as tense stops in many cases in the 1930's, are no longer realized as tense stops in PDK also seems reasonable considering the change in perceptual cue weighting in laryngeal contrast of Korean. With the increased importance of high F0 cue for tense stops, pre-consonantal voiced stops of English, which, by definition, do not carry any vocalic cue, simply cannot be matched to tense stops of Korean. But, in the 1930's when the VOT cue carried more weight in perception, pre-consonantal voiced stops were adapted as tense stops.

The role of normative orthographic convention should also be recognized in understanding the decline of tense stop adaptation of English voiced stops over the last several decades. English words began entering the Korean language during the Enlightenment period (1860-1910) and during this period and the subsequent three decades or so, there was no authoritative standard on transcription of foreign words in Korean (Yu 1988, M. R. Kim 2000). Therefore, the loanword transcriptions from this era were extremely variable and are assumed to reflect variations due to perceptual factors fairly closely as well as variations due to many other factors. The strong tendency for the transcription from this era to reflect the phonetic properties of the source sounds is illustrated by the fact that some even invented new symbols to transcribe foreign sounds that are not found in Korean (e.g.,  $\text{o}\overline{\text{v}}$  for /f/). The non-uniform adaptation of a single phoneme across segmental contexts in this period is also related to the tendency to faithfully transcribe phonetic details of the foreign sounds.

It is notable that the first orthographic convention on the language promulgated by the *Cosene Hakhwey* (current *Hangul Hakhwey*) in 1933 bans the use of novel symbols for transcribing foreign sounds, reflecting an attempt at curbing the extreme phonetic realism of loanword transcription at the time. It is only in 1940, however, when the first systematic guideline on foreign word transcription (*Weylaye Phyokipep Thongilan*) was published. Therefore, it can be assumed that the transcription used in the 1937 dictionary is fairly free from

the influence of normative orthographic convention.

In years since the liberation of Korea from the Japanese occupation in 1945, the *Ministry of Education* published a series of guidelines on foreign word transcriptions. Crucially for our discussion at hand, the guideline published in 1958 contains a specific clause that dictates that a single phoneme of a foreign language should be transcribed with a single Korean symbol and that allophonic variation in foreign phonemes should be ignored in transcription. The guideline published in 1985 further dictates that tense consonants should be avoided in transcription of foreign stops. Both of these conventions introduced in 1958 and 1985, respectively, likely have contributed to the decline in the transcription of English voiced stops as tense stops in Korean and also in actual adaptation of English voiced stops as tense stops in newly introduced English loans. It is not clear whether such orthographic convention should be viewed as a purely extra-grammatical force that merely prevents us from observing the speakers' grammatical knowledge in action in loan adaptation or alternatively, such orthographic conventions themselves emerge from certain aspects of speakers' grammatical knowledge. In either case, the introduction of these conventions go in tandem with the decline in the tense stop adaptation of English voiced stops we observed in our loanword data.

To summarize, the distribution of tense stop adaptation of English voiced stops in Korean is phonetically sensible in that the tense stops are found in contexts where the mapping is perceptually reasonable in PDK. The lack of tense adaptation in preconsonantal word-initial position and the different rates of tense adaptation for /b/ vs. /d/ are evidence for the persisting role of perceptual factors in the tense stop realization of English voiced stops in PDK English loanwords. However, the drastic decline in the overall rate of tense stop adaptation from the 1930's to PDK indicates a reorganization of perceptual cues for laryngeal contrast in Korean over the last several decades. Also, it is noted that in the intervening years, a series of authoritative guidelines on foreign word transcription have been published which likely contributed to the decline of adaptation of English voiced stops as tense stops even further. It is proposed that those words that still show tense stops for English word-initial voiced stops are fossilized remnants of loans from the earlier era, which managed to survive the pressure to shift to a lax stop due to their high frequency of occurrence.

## **6 Conclusion**

In this paper, I proposed an account of tense stop realization of English voiced stops in loanwords in Korean that takes into account perceptual factors as well as historical and orthographic factors. Loanword adaptation is a complex phenomenon that is conditioned by a range of grammatical and extra-grammatical factors. One of the goals of the current paper was to illustrate how we can understand the role of grammatical factors that affect loanword

adaptation better when we approach the phenomenon with a more comprehensive viewpoint.

## Notes

\* I would like to thank the audience at the 12<sup>th</sup> ISOKL for valuable comments. I would also like to thank Sarah Costen for entering the NAKL (1991) data into an excel file.

<sup>i</sup> In the rest of the paper, I will use the term “stops” to refer to oral stops and affricates for convenience.

<sup>ii</sup> /p\*ilt\*ij/ ~ /p\*iltij/ ‘building’ is the only exception that I am aware of.

<sup>iii</sup> See NAKL (2001) for a survey of Seoul speakers and professional announcers for their pronunciation of common English loanwords which are known for variable tensification.

<sup>iv</sup> The statistics suggests that the assertion that “[the] three-way stop system is beginning to restructure into a two way system comprising tense and aspirated stops (Shin and Davis 2004)” seems premature if not unfounded. Rather the current change seems to be shoring up the newly created tense category, which is underutilized as it is. D. G. Park (2000) observes that tensification often creates minimal pairs out of existing homophones as shown in (a) but tensification is blocked if it would result in homophony, as shown in (b). Such observation disputes the claim that the lax vs. tense contrast is disappearing from the language.

- (a) /seta/, \*/s\*eta/ ‘to count’  
/seta/ ~ /s\*eta/ ‘strong’  
/kamta/, \*/k\*amta/ ‘to tie’  
/kamta/ ~ /k\*amta/ ‘to wash (hair)’  
/cʌkta/, \*/c\*ʌkta/ ‘to jot down’  
/cʌkta/ ~ /c\*ʌkta/ ‘little (in amount)’
- (b) /kata/, \*/k\*ata/ ‘to go’  
cf. /k\*ata/ ‘to peel’  
/cata/, \*/c\*ata/ ‘to sleep’  
cf. /c\*ata/ ‘salty’  
/kalta/, \*/k\*alta/ ‘to change’  
cf. /k\*alta/ ‘to spread, put down’  
/titta/, \*/t\*itta/ ‘to listen’  
cf. /t\*itta/ ‘to pick’s

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Department of Humanities  
University of Toronto Scarborough  
1265 Military Trail, H528  
Scarborough, ON, M1C 1A4, Canada

e-mail:kang@utsc.utoronto.ca