

A production-based study of the Korean liquid in onset position*

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Seo, Misun. 2004. A production-based study of the Korean liquid in onset position. *Studies in Phonetics, Phonology and Morphology* 10-2. 257-276. Phonological theorists working on Korean has frequently assumed that there is a prohibition against a lateral consonant in syllable onset position (Iverson and Kim 1987, Han 1993, Suh 1993, Yoo 1996, Lee 2001). It has also been claimed that due to this prohibition, an underlying liquid in recent loanwords is realized as a flap, not as a lateral in onset position (Yoo 1996, Lee 2001). Based on the results from production experiments, this paper argues against the view that the prohibition against a lateral in syllable onset position is active in loanwords. According to our production experiments, an underlying liquid was realized as a lateral in most loanwords. The results from production experiments also suggest that the prohibition against a lateral is still strongly active in Sino-Korean words. According to our production experiments which included Sino-Korean words with /pL/, /kL/, /mL/, and /ŋL/, a lateral surfaced in onset position in a very small number of cases. In addition, by showing that /nL/ can be realized as either [l] or [nn], the experiment results support Seo's (2001a, 2001b, 2002) prediction on the direction of assimilation in /nL/. (Korea University)

Keywords: Korean liquid, onset, Sino-Korean words, loanwords

1. Introduction

It is frequently assumed among phonological theorists working on Korean that there is a prohibition against a lateral consonant in syllable onset position (Iverson and Kim 1987, Han 1993, Suh 1993, Yoo 1996, Lee 2001). This assumption is based on observations that there is no native Korean word beginning with a lateral and that an underlying liquid in syllable onset position is realized as [n] in Sino-Korean words, as in /Lak-wən/ [nagwən] 'paradise', /pəp-Li/ [pəmni] 'principle of law', and /kyək-Li/ [kyəŋni] 'separation' (Kim-Renaud 1974, Iverson & Kim 1987, Iverson & Sohn 1994).¹ It has also been claimed that due to this prohibition, a

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¹ “-” indicates a morpheme boundary.

liquid in recent loanwords is realized as a flap [r], not as a lateral in onset position (Yoo 1996, Lee 2001). Jun (1999, 2000) argues against the traditional view that a lateral cannot occur in onset position based on the production experiment which was run to investigate the pronunciations of an underlying liquid in Sino-Korean words with /kL/.

Based on the results of production experiments, it is argued in this paper that the prohibition against a lateral in syllable onset position is not active in loanwords. According to our experiments, a liquid was realized as a lateral in most loanwords. However, according to our production experiments involving Sino-Korean words, a lateral surfaced in onset position in a very small number of cases. This suggests that the prohibition against a lateral is still strongly active in Sino-Korean words.

In our experiments, words with /nL/ were also included as experimental tokens to investigate the realization patterns of /nL/. In previous approaches, /nL/ has been assumed to be realized as [l] in Korean. However, based on results from perception experiments, Seo (2000, 2001a, 2001b) claims that changing /nL/ either to [l] or to [nn] makes no difference in terms of perceptual salience (or noticeability), and thus both n-lateralization and L-nasalization are perceptually licit changes. Thus, we might expect to find both realizations: [nn] and [l]. Our experiment results showed that [nn] is also a possible surface form of /nL/, supporting Seo's prediction.

This paper is organized as follows. In section 2, previous approaches to the realization of an onset liquid in Sino-Korean words and loanwords are discussed. Jun's (1999, 2000) account of the realization of an underlying liquid and problems with this account are also discussed in section 2. Two experiments were run to investigate the surface forms of an underlying liquid in onset position using Sino-Korean words and loanwords. The methods, results and discussion of those two experiments are given in section 3 and 4. General discussion based on experiment results is in section 5.

2. Previous approaches

2.1 Traditional description of the realization of a liquid in the onset

Sino-Korean words refer to the words borrowed from Chinese. In Sino-Korean words, interesting alternation patterns of one segment are found. The Sino-Korean morpheme 'to discuss' contains such a segment and as an example, alternations of the segment in the morpheme are given below.

- (1) Alternations of Sino-Korean morpheme 'to discuss'
- a. [kyəɫ-lon] 'conclusion'
 - b. [i-rɔn] 'theory'
 - c. [non-ceŋ] 'argument'

/L/ is used in representing an underlying liquid to avoid any claim about an underlying form for liquid.

The first segment of the morpheme ‘to discuss’ shows different surface forms depending on the quality of adjacent segments. As the example in (1a) shows, the first segment of the morpheme is realized as a lateral after another lateral, and it surfaces as a flap intervocalically as the example in (1b) shows. In addition, it appears as a nasal [n] in word-initial onset position as the example in (1c) illustrates. There are lots of other Sino-Korean morphemes showing these alternation patterns. The underlying form of the segment has been claimed to be a lateral (Kim-Renaud 1991, Iverson & Kim 1987 among others), a flap (Lee 1950, Kim 1971), or a liquid (Iverson & Sohn 1994). It is not crucial in our discussion what the underlying form of this segment is; consequently it will be referred to simply as an underlying liquid in this paper.

As illustrated in the examples in (2), an underlying liquid has been described as being realized as [n] when a non-coronal stop or nasal precedes, changing a preceding consonant to a nasal when it is a stop.² However, when a coronal consonant /L/ or /n/ precedes, it has been analyzed that an underlying liquid surfaces as [l].

(2) Realization of post-consonantal onset /L/

(Iverson & Kim 1987, Iverson & Sohn 1994, Lee 2001)

a. After a non-coronal consonant

/pək-Lak-wən/	[pɔŋnagwən]	‘Paradise Recovered’
/pəp-Lyul/	[pəmnyul]	‘law’
/sam-Lyu/	[samnyu]	‘third-rate’
/yəŋ-Lak/	[yəŋnak]	‘downfall’

b. After a coronal consonant

/moLLe/	[molle]	‘secretly’
/muL-Li/	[mulli]	‘physics’
/muL-nan-Li/	[mullalli]	‘flood’
/səL-naL/	[səllal]	‘New Year’s Day’

2.2 Prohibition against a lateral in the onset

Based on an observation that there is no native Korean word with a lateral in the onset and on the realization patterns of an underlying liquid given in section 2.1, it is frequently assumed that there is a prohibition against a lateral consonant in syllable onset position in Korean. To represent this phonological property, a rule or a constraint as in (3) has been posited.

² It has been analyzed that /tL/ is realized as [ll] based on the example /tikit + Liil/ → [tikillil] ‘the letters *t* and *l*’ (Iverson & Sohn 1994, Davis & Shin 1999). To our knowledge, this is the only example with the /tL/ sequence. Thus, the realization pattern of an underlying liquid after a coronal stop was excluded in our study.

- (3) a. /L/ → [n] / {C, #} _____ (Iverson & Kim 1987 among others)
 b. *Onset-l condition (Yoo 1996): The occurrence of [l] is ruled out in onset position.

Iverson & Kim (1987) and Iverson & Sohn (1994) view the change of an underlying liquid into a nasal [n] as a strengthening process in syllable initial position where, according to Vennemann (1988), a stronger, lower sonority segment is preferred cross-linguistically. They thus posit the rule in (3a) which says that an underlying liquid changes to [n] in onset position. Within an Optimality Theoretic approach, Yoo (1996) posits the highly-ranked constraint in (3b) to account for the non-occurrence of [l] in onset position in both Sino-Korean word and loanword pronunciations.

Lee (2001) explains the non-occurrence of a lateral in the onset in terms of the highly-ranked constraint *Non-moraic-l in (4). This constraint is based on Lee's assumption that a lateral in Korean must occur in a moraic position in order to be licensed. Thus, it may appear only in the coda or as a part of a geminate lateral. Lee assumes that onsets are non-moraic and thus a lateral cannot occur in the onset.

- (4) *Non-moraic-l (Lee 2001)
 Do not have [l] in a non-moraic position.

It is assumed that the prohibition against a lateral in onset position is still active in Korean phonology. This is based on the observation that an underlying liquid in loanwords is realized as [r] word-initially regardless of whether the source word begins with /l/ or /r/, as the following examples illustrate (Kim 2000, Lee 2001).

- (5) [risit^hi] 'list' [resit^horaŋ] 'restaurant'
 [robi] 'lobby' [rot^hari] 'rotary'

2.3 Jun (1999, 2000)

Jun's (1999, 2000) production experiment results question the view that the prohibition against a lateral in onset position is still strong in Korean phonology by showing that an underlying liquid can surface as a lateral in onset position in Sino-Korean word pronunciations.³

³ Jun conducted two types of production experiments, 'forced speech' and 'natural speech', to investigate the realization patterns of an underlying stop plus liquid sequence. In the 'forced speech' experiment, Seoul and Kyungsang dialect speakers participated in the experiment and speakers were asked to produce the spelling pronunciation of the liquid of a word in citation form. That is, Jun requested speakers to pronounce an underlying liquid as a liquid to find out whether or not an obstruent is nasalized when the liquid after it is not nasalized. Since the realization patterns of the liquid were obtained by the experimental method forcing subjects to give spelling pronunciations and the experiment results could be influenced by speakers' dialect differences, we will focus on the results from Jun's natural speech experiment.

In Jun's 'natural speech' experiment, subjects were all Seoul Korean speakers, and two words /tɛ-hak-Lo/ 'University street' and /kuk-Lip/ 'national' were used in the experiment. To induce natural speech, these two selected words were put within sentential contexts, and subjects were asked to read each sentence. Tokens obtained from this experiment were transcribed by two phoneticians and subsequently analyzed by Jun in order to determine the realization patterns of an underlying liquid.

Based on this production experiment, Jun reports that in an underlying velar stop plus liquid sequence, a lateral occurred in syllable onset position in 5 out of 25 tokens, contrary to the traditional view that a lateral cannot surface in onset in Korean. In addition, Jun's experimental results show that an underlying liquid can have variability in its realization by surfacing as a nasal (17 out of 25 tokens) or a nasalized lateral (3 out of 25 tokens). These results are not compatible with the traditional analysis that only the nasal can be the surface form of an underlying liquid in a /kL/ sequence.

To account for the observation that an underlying liquid can be realized as a lateral in post-consonantal onset position, Jun suggests that it is the result of historical reanalysis. That is, in the first stage, there were no native Korean words beginning with an underlying liquid, and thus an initial liquid in foreign (Sino-Korean) morphemes changed into a nasal [n] to obey a constraint prohibiting an onset liquid. Then, with the massive borrowing of foreign (mainly English) words with an initial liquid, Korean speakers produced word-initial liquids. This triggered a reanalysis of nasals into liquids in some Sino-Korean words.

Jun's finding that a lateral can occur in onset position is problematic for previous accounts using an L-nasalization rule (Iverson & Kim 1987 among others) or a highly ranked constraint such as *Onset-l condition (Yoo 1996) or *Non-moraic-l (Lee 2001). His result suggests that such rules or constraints are no longer active in Korean phonology.

However, these production experiments provide a limited range of information about the realization patterns of a liquid in onset position since only two words with an underlying velar stop plus liquid sequence were employed as experimental tokens. Therefore, it is necessary to investigate the realizations of a liquid by using words with preceding consonants which have different places and manners of articulation. Also, to see whether or not the prohibition against a lateral in onset is still active in Korean phonology, it is necessary to investigate how an onset liquid in loanwords is adapted by Korean native speakers. For this, we ran production experiments using Sino-Korean words and loanwords with /pL/, /kL/, /mL/, /ŋL/, and /nL/. Loanwords with a word-initial liquid were also included.

3. Production experiment 1: Sino-Korean words

A production experiment was designed to investigate the realization

patterns of an underlying post-consonantal liquid in Sino-Korean words.

3.1 Methods

3.1.1 Procedures

For the production experiment, Sino-Korean words assumed to have an underlying /pL/, /kL/, /mL/, /nL/ and /ŋL/ sequence were included.⁴

Word frequency was taken into account as a factor which might influence production. Considering that speakers will tend to give more innovative pronunciations for unfamiliar words, it is hypothesized that there would be more variability in the realization of an underlying liquid in words that occur less frequently. To test this hypothesis, for each word used with an underlying liquid in a specific position, frequent and infrequent words were taken from a Korean frequency dictionary.⁵ 10 frequent and 10 infrequent words with /kL/ or /nL/ were taken, respectively. In the case of /pL/, /mL/, and /ŋL/, given that these sequences were less frequent overall, less than 10 words were included. Sample words used in the production experiment are as follows (for the complete recorded corpus, see appendix A):

(6) Experimental tokens: Sino-Korean words with /pL/, /kL/, /mL/, /nL/ and /ŋL/ sequences

Sequences	Frequent words	Infrequent words
/pL/	/paŋ-pəp-Lon/ 'methodology'	/kap-Lon-iL-pak/ 'pros and cons'
	/səp-Li/ 'providence'	/kip-Lak/ 'success or failure'
/kL/	/kuk-Lip/ 'national'	/kuk-Lok/ 'government salary'
	/tok-Lip/ 'independence'	/nok-Lim/ 'green forest'
/mL/	/kim-Li/ 'interest rate'	/kyəŋ-həm-Lon-ca/ 'a man of experience'
	/nim-Lim/ 'being high-spirited'	/həm-Lo/ 'rough road'
/ŋL/	/kaŋ-Liŋ/ name of city	/tiŋ-Lak/ 'rise and fall'
	/kyəŋ-Lo/ 'course'	/maŋ-La/ 'bringing together'
/nL/	/kin-Le/ 'nowadays'	/kun-Lim/ 'reigning'
	/kin-Lo-ca/ 'worker'	/kwe-pyən-Lon/ 'sophistry'

⁴ As the result of reflecting the pronunciation into the orthography, /L/ in word-initial onset position is spelled using the same character as the one for an alveolar nasal. Thus, Sino-Korean words with /L/ in word-initial onset position could not be included as the experimental tokens.

⁵ The word frequency is based on Korean word frequency data from Language Research Institute in Yonsei University. I would like to thank Seok-Bae Jang and Sun-Hee Lee who helped me a lot so that I was allowed to get the unpublished data.

10 (or less than 10) most frequent words and 10 (or less than 10) most infrequent words having /L/ in a specific position were taken from a frequency dictionary.

Every syllable with the liquid in onset position in each experimental token is a Sino-Korean morpheme. It is widely assumed that it is the liquid underlyingly because it surfaces as the liquid when each of these morphemes combines with other Sino-Korean morphemes. As discussed in 2.1, an underlying liquid surfaces as [r] intervocally, and as [l] after another liquid.⁶ Thus, for example, the liquids in /Lon/ (which appears in ‘methodology’) and /Lak/ (which appears in ‘success and failure’) show such realization patterns intervocally and after another liquid, as shown in the following examples:

- (7) a. /i-Lon/ [iron] ‘theory’
 /kyəL-Lon/ [kyəllon] ‘conclusion’
- b. /ç^h u-Lak/ [ç^h urak] ‘crash’
 /t^h aL-Lak/ [t^h allak] ‘falling off’

Each word was put in a sentential context which differed depending on the target word in order to induce natural speech. Each target word occurred in utterance-medial and accentual phrase-initial position in order for the influence of prosody on productions to be minimized, as shown in the following example:

- (8) a. /yəkɪ-sə kəkɪ-k’acɪnɪn sip-Lɪ-kiL-ita/
 here-from there-to ten-unit-distance-Dec.
 ‘It is a ‘sɪpli’ distance from here to there.’

Recordings were made in a sound-attenuated booth at Ohio State University. Each sentence with a target word was written on an index card, and presented to the speakers one at a time. Speakers were asked to read each presented sentence at a natural speech rate once. Index cards were shuffled each time recordings were made. Thus, cards were presented in different orders to different speakers. For the recording, a head-mounted microphone was used. Recordings were digitized at 22050 Hz, and each experimental token was excised from the sentence containing it prior to being transcribed.

3.1.2 Subjects

10 native speakers of Seoul Korean participated in the production experiment, of whom 5 were male and 5 were female. They were students at Ohio State University, with all having lived in the U.S. between 9 months and 6 years (average 3.5 years).

⁶ The underlying nasal /n/ is realized as [n] intervocally, as in /te-ne/ → [tene] ‘domestic’.

3.2 Results

In order to obtain a precise phonetic transcription of the underlying liquid, recordings were transcribed by three phoneticians who are native speakers of American English. Production data were not transcribed by native speakers of Korean to avoid potential native language effects. Transcriptions were made after listening to the tokens and looking at the spectrograms. Tokens for which two phoneticians reached identical or almost identical judgments were used for the analysis.

The table in (9) shows the distribution of surface forms of the underlying liquid in a /pL/ or /kL/ sequence. In the table below, the numbers in the 'complete match' column represent the number of identical transcriptions for a given token by at least two phoneticians. The numbers in the 'loose match' column illustrate an additional number of transcriptions given by at least two phoneticians which are identical except for added nasalization, retroflexion, palatalization, etc. For example, for frequent words with /pL/, at least two phoneticians transcribed the underlying lateral as an alveolar nasal [n] in 45 out of 50 tokens (5 words × 10 speakers), and in one additional case at least two phoneticians' transcriptions matched when an additional (i.e. secondary) articulation was ignored.

(9) Judgments on the underlying liquid in Sino-Korean words with /pL/ and /kL/

		Complete match				Loose match	
		n	l	ɭ	deleted	nasal	lateral
/pL/	Frequent Words (Total: 50)	45	0	1	0	1	1
	Infrequent Words (Total: 50)	44	2	2	0	0	1
/kL/	Frequent Words (Total: 99)	84	1	0	0	8	3
	Infrequent Words (Total: 98)	76	2	5	1	3	2

As shown in the table above, in cases of Sino-Korean words with a non-coronal stop consonant preceding an underlying liquid, the underlying liquid was realized as a nasal [n] in most cases, as in the traditional analysis. As in Jun's (1999, 2000) results, the underlying liquid also surfaced as a lateral or nasalized lateral but in our data this was limited to a small number of tokens. There is one case where the underlying liquid in /kL/ is deleted, and this might be considered as an exceptional case.

Contrary to our hypothesis that an underlying liquid in infrequent words will show more variability in its surface form, frequent and infrequent words showed no significant difference in the realization patterns of an underlying liquid.

The realization patterns of a liquid in tokens with a /mL/ or /ŋL/ sequence are shown in the table below.

(10) Judgments on the underlying liquid in /mL/ and /ŋL/

		Complete match				Loose match	
		n	l	ɭ	deleted	nasal	lateral
/mL/	Frequent Words (Total: 67)	60	1	0	0	0	5
	Infrequent Words (Total: 69)	60	1	2	0	0	5
/ŋL/	Frequent Words (Total: 90)	71	0	1	0	3	2
	Infrequent Words (Total: 90)	67	0	3	1	3	6

As in the traditional analysis, the liquid in /mL/ and /ŋL/ sequences was realized as a nasal [n] in most cases, and in a small number of tokens it was realized as a lateral or nasalized lateral. Frequent and infrequent words were not significantly different in the realization patterns of an underlying liquid.

The table below displays the distribution of the surface forms of /nL/ (spectrograms of utterances with /nL/ are given in appendix B).

(11) Judgments on the realization of /nL/

	Complete match						Loose match	
	ɭɭ	ɭl	nn	ɔl	ɔn	nl	lat. lat	ɔ lat.
Frequent Words (Total: 67)	25	5	0	5	0	0	58	4
Infrequent Words (Total: 69)	18	2	20	3	2	1	43	2

The /nL/ sequence was realized as [ɭɭ] in the production experiment in most tokens if completely and loosely matched transcriptions are considered, supporting the traditional analysis that n-lateralization occurs in /nL/. The realization patterns of /nL/ in frequent and infrequent words are different in that, contrary to the traditional analysis, /nL/ surfaced as [nn] in some tokens from infrequent words. This result supports our hypothesis that

⁷ Some speakers mistook the word /sam-Lim/ 'forest' for /san-Lim/ 'forest' and pronounced /sam-Lim/ as [sallim]. The mispronounced tokens were left out of the results.

there would be more variability in the realization of an underlying liquid in words that occur less frequently.

3.3 Discussion

The results of our production experiments show that an underlying liquid in the onset is most frequently realized as [n] in Sino-Korean words when a noncoronal stop or nasal precedes it. As in Jun's (1999, 2000) results, an underlying liquid surfaced as a lateral in onset, but it was limited to a very small number of tokens. Thus, this result implies that a prohibition against a lateral in onset is still rigid in Sino-Korean words.

According to our production experiments, the realization patterns of /nL/ in frequent and infrequent words are different in that, contrary to the traditional analysis, /nL/ surfaced as [nn] in some tokens from infrequent words. This result is partly due to the fact that /kwɛpyənLon/ 'sophistry' and /poanLim/ 'reserved forest' are included as experiment tokens. According to Lee (1996), the /nL/ sequence in compounds consisting of a free and a bound morpheme is realized as [nn]. Thus, according to this, it is expected that /nL/ in /kwɛpyənLon/ and /poanLim/ will be realized as [nn], and in our production experiment, most speakers followed this pattern. However, the infrequent word /sənLin/ 'good neighbor relationship' was pronounced as [sənnin] by 9 out of 10 speakers, and the /nL/ sequence in /kunLan/ 'army rebellion' was pronounced as [nn] by some speakers. All of these are unexpected results according to Lee's analysis, where it is predicted that /nL/ in these words will be realized as [l].

However, according to Seo's (2001, 2002a, 2002b) perceptual account, this is a possible and expected result. According to Steriade (2001), speakers' behavior is guided by a model of the generic listeners' perceptual abilities and biases. This model of the generic listener, which is called the P-map, has the function of identifying regions of relative safety within which a speaker can deviate from established pronunciation norms while minimizing the risk of being noticed. Thus, as the result of modification, among possible output forms for a given input, the one that differs least from the unmodified input form is preferred. Following Steriade (2001), Seo hypothesizes that both n-lateralization and l-nasalization are found in n/l sequences cross-linguistically since both [l] and [nn] are perceptually similar to, and hence, easily confused with, /n/ and /l/. In other words, it is hypothesized that both changing [l] to [n] and changing [n] to [l] are perceptually allowed changes in n/l sequences. In her perception experiment with native speakers of Korean, paired stimuli [anla]/[alla], [anla]/[anna], [alna]/[alla] and [alna]/[anna] recorded by a male Hindi speaker were presented and listeners were asked to determine whether members of a pair of stimuli they heard were the same or different. According to the experiment results, Korean listeners showed no significant difference in perceiving between the change of /l/ to [n] and that of /n/ to [l], suggesting

Recordings of the experimental tokens in (14) were made by two male speakers who participated in the first experiment. To induce natural speech, each target word was put within a different sentential context. To avoid the influence of prosody, each target word was put in utterance-medial, accentual phrase-initial position.

- (15) /i totpoki-e is'nin kəs-i poLLokLenci-ta/
 this glasses for the aged-in existing thing-Subj. marker a convex lens-Dec.
 'Lenses in these glasses for the aged are convex ones.'

For the second production experiment, the same method used in the first experiment was used.

4.2 Results and discussion

In order to obtain a precise phonetic transcription of an underlying liquid, recordings were transcribed by phoneticians after listening to the tokens and looking at the spectrograms. Recordings of loanwords with a word-initial /L/ were transcribed by the same three phoneticians who transcribed the recordings from the first experiment, and tokens for which at least two phoneticians reached identical or almost identical judgments were used for the analysis. Loanwords with a post-consonantal onset /L/ were transcribed by two of the same group phoneticians; tokens for which both phoneticians reached identical or almost identical judgments were analyzed.

The realization patterns of a word-initial underlying liquid in loanwords are illustrated in the table below (for spectrograms of utterances showing different surface forms of /L/, see appendix D).

(16) Judgments of a word-initial liquid in loanwords

	Complete match							Loose match		
	l	ɭ	ɾ	ɽ	ɖ	t	d	alv. stop	lat.	ret.
Frequent Words (Total: 100)	40	1	10	3	1	0	0	8	13	2
Infrequent Words (Total: 100)	47	5	6	2	0	1	2	3	13	6

A word-initial underlying liquid was realized as a lateral in most tokens.⁸

⁸ In tokens with a word-initial /L/, significant gender difference was found. Male speakers tend to pronounce a word-initial /L/ as a lateral more than female speakers. The gender difference was more conspicuous in cases of the frequent words. When both completely and loosely matched transcriptions are considered, male speakers pronounced a word-initial /L/ in frequent loanwords as a lateral in 41 tokens, while female speakers pronounced it as a lateral in 13 tokens. In cases of the infrequent loanwords with a word-initial /L/, gender difference

The underlying liquid in this position also showed more variability in its surface form by being realized as a lateral, a retroflex, and even a stop. This result could be related to the fact that Korean speakers are relatively unfamiliar with loanwords, compared with Sino-Korean words, and thus they gave more innovative pronunciations. There was no significant difference between frequent and infrequent words in the realization patterns. Unlike the previous description that a word-initial underlying liquid in loanwords surfaces as a flap due to the constraint prohibiting a lateral in the onset, it was not realized as a flap in any token in our experiment, suggesting that the prohibition against a lateral in onset position is no longer active in loanwords.

The table in (17) shows the distribution of surface forms of the liquid of loanwords in post-consonantal onset position.

(17) Judgments of the liquid in /pL/, /kL/, /mL/, and /ŋL/

	Complete Match		Loose Match
	lateral	Nasalized lateral	lateral
/pL/ (Total: 4)	1	1	2
/kL/ (Total: 4)	1	1	0
/mL/ (Total: 4)	1	0	2
/ŋL/ (Total: 4)	0	1	2

As shown in the table above, the liquid of loanwords in /pL/, /kL/, /mL/ and /ŋL/ was realized as a lateral in most tokens and it was never realized as a nasal [n], supporting our earlier conclusion that a prohibition against a lateral in onset is not productive in loanwords.

The realization patterns of the /nL/ sequence are as follows:

(18) Judgment on the realization of /nL/

	Complete Match	Loose Match
	n n	nasal lateral
/nL/ (Total: 8)	1	4

Unlike in Sino-Korean words, /nL/ in loanwords was realized as a sequence of nasal and lateral in most cases if a secondary articulation such as retroflexion or nasalization in transcriptions is ignored. There were no

was smaller. Male speakers pronounced a lateral in 37 tokens, and female speakers pronounced a lateral in 28 tokens.

No significant effect of length of stay in U.S. was found.

cases of [ll] in the tokens. The result that /nL/ mostly surfaced as a nasal plus lateral sequence may be related to the fact that almost all the tokens with /nL/ used in the experiment were compound words obtained by combining a Korean word ending in /n/ and a loanword beginning with /L/, with a word boundary falling between /n/ and /L/. As shown in (16) and (17), speakers pronounced a word-initial /L/ in loanwords as a lateral, and this may influence the pronunciation of /nL/ in loanwords.

5. General discussion

Our production experiments showed that a liquid in post-consonantal onset position had different surface forms in Sino-Korean words and in loanwords. In Sino-Korean words, it mainly surfaced as a nasal [n] when the preceding consonant is non-coronal, supporting the traditional approach. However, it was mainly realized as a lateral [l] in loanwords when a non-coronal consonant preceded it. In addition, a word-initial underlying liquid mostly surfaced as a lateral, rejecting the previous analysis that it surfaced as a flap [ɾ]. This result implies that the prohibition against a lateral in onset position is no longer active in loanwords while it is in Sino-Korean words.

One might argue that the speakers involved had high familiarity with English by living in an English speaking community and thus knew which sound corresponded to the lateral in the source word. Their pronunciations were therefore influenced by this. However, the experimental tokens with a word-initial liquid included words such as /Ləsia/ 'Russia', /Loma/ 'Rome', /Lipon/ 'ribbon', etc., and the first segment in those words was pronounced as a lateral in 60 out of 90 tokens (where phoneticians' transcriptions matched completely or loosely).

This result is problematic for Lee's (2001) claim that [l] cannot surface in onset position in loanwords due to the *Non-moraic-l constraint, which prohibits the lateral in non-moraic positions. One way to make her analysis work would be to claim that the onset is moraic in Korean. This is problematic, however, in that onset consonants cannot be moraic since they do not contribute to the weight of their syllable (Hayes 1989). As an alternative, the *Non-moraic-l constraint could be assumed to be lowly ranked in loanword phonology.

Jun (1999, 2000) provides an account of the occurrence of the lateral in Sino-Korean words in terms of historical reanalysis: Korean speakers pronounce a lateral in onset position as the result of the recent borrowed words with a lateral in the onset. Jun's account predicts that Korean speakers having high familiarity with English will tend to pronounce laterals in onset position more than speakers having low familiarity with English. Thus, considering that speakers who participated in our production experiments were the ones assumed to be familiar with English, this could be a reason for the result that in our experiment, an underlying liquid

in loanwords mainly surfaced as a lateral in onset position.

6. Conclusion

This paper investigated the realization patterns of a liquid in Sino-Korean words and in loanwords. The results of the production experiments show that its realization patterns are different in Sino-Korean and loanwords. In Sino-Korean words, an underlying liquid was mainly realized as a nasal, suggesting that the constraint prohibiting a lateral in the onset is still rigid. On the other hand, in loanwords it was mainly realized as a lateral, implying that the prohibition against a lateral in onset position is not active in loanword pronunciation.

In the case of the /nL/ sequence, contrary to the traditional analysis that it is realized as [l], both [ll] and [nn] were possible surface forms in Sino-Korean words, as predicted in Seo (2001a, 2001b, 2003). In loanwords, /nL/ was realized as a sequence of a nasal and a lateral in most tokens, however, thus implying that n-lateralization and L-nasalization are not productive when an underlying liquid is a part of a loanword.

Appendix A. Experimental tokens

Sino-Korean words with /pL/, /kL/, /mL/, /nL/ and /ŋL/ sequences

a. /pL/

Frequent words	Infrequent words
/paŋpəpLon/ ‘methodology’	/kapLonɪLpak/ ‘pros and cons’
/səpLi/ ‘providence’	/kipLak/ ‘success or failure’
/hapLicək/ ‘rational’	/pəpLi/ ‘legal principles’
/sipLi/ ‘10 li = 4 kilometers’	/ipLon/ ‘establishment of theory’
/apLokkaŋ/ ‘Aplok river’	/cikəpLan/ ‘occupation column’

b. /kL/

Frequent words	Infrequent words
/kukLip/ ‘national’	/kukLok/ ‘government salary’
/tokLip/ ‘independence’	/nokLim/ ‘green forest’
/hwakLip/ ‘establishment’	/səkLan/ ‘stone railing’
/p okLo/ ‘disclosure’	/cakyəkLu/ ‘water clock’
/mokLok/ ‘list’	/hihinakLak/ ‘rejoicing’
/kikLak/ ‘paradise’	/cikLip/ ‘standing erect’
/pokLi/ ‘welfare’	/muyəkLo/ ‘trade route’
/munhakLon/ ‘theory of literature’	/pokLok/ ‘happiness’
/sincakLo/ ‘newly constructed road’	/capmokLim/ ‘scrubs’
/akLaL/ ‘wickedness’	/hakLi/ ‘academic theory’

c. /mL/

Frequent words	Infrequent words
/kimLi/ ‘interest rate’	/kyəŋhəmLonca/ ‘a man of experience’
/nimLim/ ‘being high-spirited’	/həmLo/ ‘rough road’
/pəmLam/ ‘flooding’	/yəmLa/ ‘hell’
/samLak/ ‘three types of joy’	/cakp ^h umLon/ ‘theory of literary work’
/simLi/ ‘psychology’	/t ^h amLa/ place name
/samLim/ ‘forest’	/namLu/ ‘being shabby’
/imLan/ ‘lewdness’	/puntamLon/ ‘theory of division’

d. /nL/

Frequent words	Infrequent words
/kinLe/ ‘nowadays’	/kunLim/ ‘reigning’
/kinLoca/ ‘worker’	/kwepyənLon/ ‘sophistry’
/nanLo/ ‘fireplace’	/sanLan/ ‘laying eggs’
/nanLi/ ‘uproar’	/sənLin/ ‘good neighbor relationship’
Frequent words	Infrequent words
/nonLi/ ‘logic’	/c ^h ənLe/ ‘heaven-sent’
/ponLe/ ‘originally’	/kunLan/ ‘army rebellion’
/sinLa/ country name	/munLikwatehak/ ‘college of liberal arts’
/ənLon/ ‘mass media’	/poanLim/ ‘reserved forest’
/yənLak/ ‘contact’	/yənLo/ ‘old age’
/honLan/ ‘commotion’	/yunLakka/ ‘brothel’

e. /ŋL/

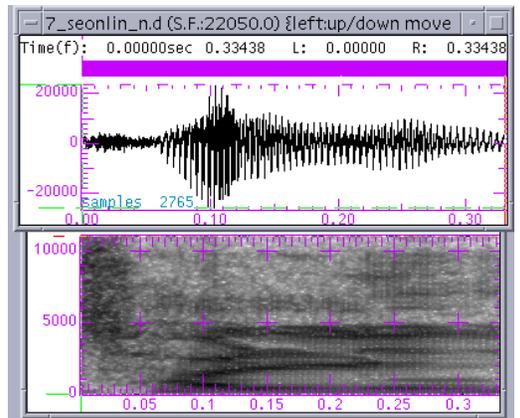
Frequent words	Infrequent words
/kaŋLiŋ/ name of city	/tiŋLak/ ‘rise and fall’
/kyəŋLo/ ‘course’	/maŋLa/ ‘bringing together’
/kuŋLi/ ‘deliberation’	/myəŋLi/ ‘fame and wealth’
/tiŋLok/ ‘registration’	/pekyaŋLo/ street name
/siŋLi/ ‘victory’	/saŋLon/ ‘full discussion’
/yəŋLi/ ‘being bright’	/sukmyəŋLoncək/ ‘being fatalistic’
/cəŋLi/ ‘organization’	/cəŋLaŋ/ ‘paramour’
/myəŋLaŋ/ ‘being pleasant’	/cəŋLu/ ‘bell tower’
Frequent words	Infrequent words
/yəŋLak/ ‘downfall’	/heŋLakkek/ ‘tourist’

Appendix B. Spectrograms of a Sino-Korean word with /nL/experimental Tokens

The spectrogram in (a) illustrates an utterance in which /nL/ was

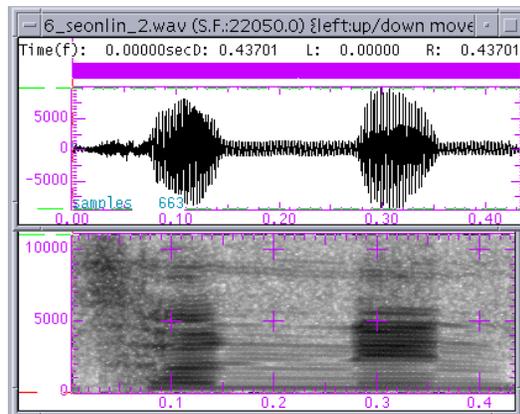
pronounced as [l], and a spectrogram of an utterance in which /nL/ was realized as [nn] is shown in (b).

a. /sənlɪn/ → [səllɪn] ‘good neighbor relationship’



[s ə l l i n]

b. /sənlɪn/ → [sənnɪn] ‘good neighbor relationship’



[s ə n n i n]

Appendix C. English loanwords with a word-initial liquid

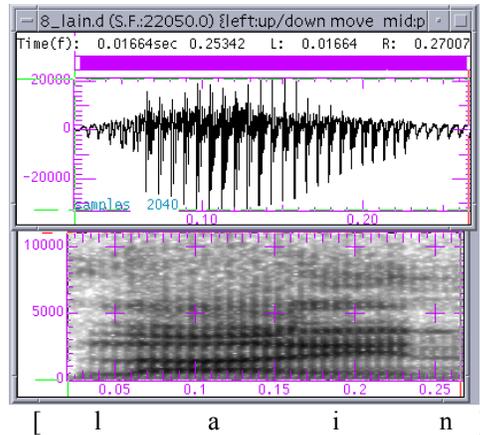
Frequent words		Infrequent words	
/Lain/	‘line’	/Laok ^h on/	‘Laocoon’
/Lɔndən/	‘London’	/LainhaLi ^h i/	‘Reinhardt’
/Lum/	‘room’	/Lent ^h ən/	‘lantern’
/Lisi ^h i/	‘list’	/LeipiL/	‘label’
/Lait ^h ə/	‘lighter’	/Let ^h eLi/	‘label’

Frequent words		Infrequent words	
/Lɔsia/	‘Russia’	/Lomansiə/	‘Romance languages’
/Lekoti/	‘record’	/Lokk ^h inLoL/	‘Rock ‘n Roll’
/Loma/	‘Rome’	/Liŋkə/	‘injection of Ringer’s solution’
/Lipon/	‘ribbon’	/Leinkot ^h i/	‘raincoat’
/Lenci/	‘lens’	/Lummeit ^h i/	‘roommate’

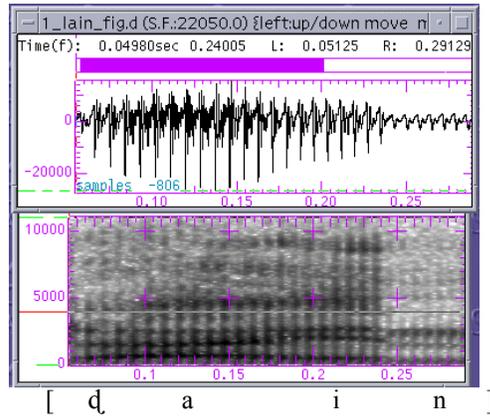
Appendix D. Spectrograms of loanwords with a liquid

Spectrograms of utterances in the following illustrates different realizations of a word-initial liquid in loanwords.

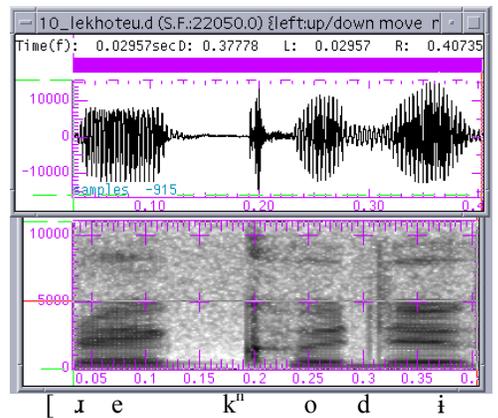
a. /Lain/ → [lain] ‘line’



b. /Lain/ → [ɖain] ‘line’



c. /Lek^hoti/ → [ɾek^hodi] ‘record’



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