Nasalization and Tapping in Yonbyon Korean

Hyunsook Kang (Hanyang University)*
Jeong-Im Han (Konkuk University)

Kang, Hyunsook & Han Jeong-Im. 2002. Nasalization and Tapping in Yonbyon Korean. *The Linguistic Association of Korea Journal*, *10*(4), 1-21. This study first presents acoustic data on the phonetic realization of an underlying liquid in Yonbyon Korean which is not nasalized after a surface nasal, but rather appears as a tap. It also presents the phonetic realization of a pre-liquid obstruent. It then presents an optimality-theoretic account of the different surface forms of an underlying liquid (McCarthy and Prince 1993, 1995, etc.) and those of a pre-liquid obstruent in Yonbyon Korean.

Key Words: Yonbyon dialect, liquid, lateral, tap, pre-liquid nasalization

1. Introduction

This study has two major goals. One is to report an interesting case of nasalization in the Yonbyon dialect of Korean which is spoken in China (henceforth YB), using acoustic data. The other is to present an optimality-theoretic account of allophones of liquid and the transformed nasal from an obstruent before an underlying liquid in Yonbyon Korean.

Traditionally, the nasalization of the /obstruent+liquid/ clusters in South Korean (/kyəklyə/ -> [kyəŋnyə] 'encouragement') is accounted for by Lateral Nasalization followed by Nasal Assimilation as in (1) (Kim-Renaud 1974; Cho 1997 among others).

* This work was supported by Hanyang University in the program year of 2001.

(1) Nasalization in (south) Korean

underlying form	/kyəklyə/	'encouragement'
Lateral Nasalization	kyəknyə	
Nasal Assimilation	kyəŋnyə	
surface form	[kyəŋnyə]	

However, nasalization not triggered by a nasal is attested in YB.

(2) Nasalization in Yonbyon Korean

underlying form	/kyəklyə/	'encouragement'
surface form	[kyəŋɾyə]	

As (2) indicates, the underlying /l/ in YB does not appear as a nasal on the surface, even though the preceding obstruent /k/ is realized as a homorganic nasal. Here we consider the phonetic output from /l/ as a tap.

A tap is argued to be a segment derived from a trill - more generally rhotic -, or a stop, involving contact between the tongue tip/blade and the region on/near the alveolar ridge (Ladefoged 1993; Kahn 1976; Catford 1988; Banner-Inouye 1995; Ladefoged and Maddieson 1990; de Jong 1998). Usually the tap has a very brief contact, and thus its closure duration appears to be significantly shorter than that for a stop or a trill. As for the American English tap, its mean duration is 26 ms, as against 75 ms for [d] and 129 ms for [t] (Steriade 2000). However, except for this alternation relationship between a trill/stop and a tap, and extra short duration of the tap, the phonetic characteristics the tap shows are various. For example, Ladefoged (1993) points out that the tap allophone of a trill has different articulation from that of a stop. They are argued to be regarded as comprising a single class of "tap" only because they are auditorily similar. For this reason, the tap realized as an alveolar rhotic on the surface can be described with the feature combination [+sonorant, +continuant], distinguishable from the corresponding stops. On the other hand, the tap which is realized as a voiced alveolar stop

on the phonetic representation can be described with the feature [+voice] to be distinguished from [t] and [-sonorant], from [r] (Banner-Inouye 1995).

Despite these various phonetic characteristics that the tap shows, the tap is uncontroversially argued to be derived from the corresponding stop or trill in terms of lenition, weakening of sounds. The tap is considered to have a reduced oral stricture as compared to the corresponding stop or trill. American English Tapping, for example, is argued to result from the reduction of an alveolar stop to a tap (Kahn 1976). Thus, together with all other lenited segments, the tap occurs more readily in prosodically weak position. According to the typological survey of the tap by Banner-Inouye (1995), the tap is found either in final or intervocalic position which is typical lenition environment.

In this study we will observe a type of tap which is unique in that even though it shows general properties of the tap such as short duration and an alveolar contact, it appears in syllable-initial position, as an obstruent, not a sonorant.

The organization of this paper is as follows: in section 2, we will conduct an acoustic study on the phonetic realization of an underlying liquid /l/ in Yonbyon dialect. Based on the spectrographic data, the phonetic realization of each liquid will be examined. In Section 3, we will motivate constraints to account for the various surface forms of an underlying liquid /l/ and the transformed nasal from an underlying obstruent in YB. Section 4 concludes the paper.

2. Phonetic Experiments on a Liquid in Yonbyon Korean

2.1. Experiment

This study has grown out of a YB native speaker's observation that an underlying /obstruent + liquid/ sequence does not surface as two nasal segments in her dialect as it does in South Korean. She claimed

that "no underlying laterals in YB surface as nasals, but appear as [l] or [ɾ]." This study uses acoustic data to test such native's intuition or impressionistic observation of laterals.

2.2. Methods

2.2.1. Stimuli

The test tokens were constructed by considering various phonological and morphological contexts as shown below.

(3) test words

	phonological context	test words
a.	V__V	yulæ 'origin'
		kolip 'isolation'
		sulyek 'hydraulic power'
		mulotoŋ 'no work'
	#__	lotoŋ 'labor'
	__#	tol 'stone'
	V__ __V	tallyek 'calendar'
		sillye 'rude'
b.	[--obstruent + __--]$_{word}$	kyəklyə 'encouragement'
		hyəplyək 'cooperation
		hapli 'reasonableness
	obstruent]$_{word}$+__	yəkkoklo 'Yokkok street'
		tapsipli 'Tapsip area
c.	[--nasal + __--]$_{word}$	kɨnlo 'work'
		cənlyək 'electric power'
		lanli 'disturbance'
	nasal]$_{word}$+__	sinmunlo 'Sinmun street'
		hyangsinlyo 'spice'

The examples in (3a) are provided to check whether YB has /l/ variants similar to SK liquids in various phonological positions other

than the post-consonantal one. More specifically, underlying /l/s in intervocalic, word-initial, and word-final positions are considered. Lateral geminates in intervocalic position are also considered for this purpose.

The examples of post-consonantal laterals in underlying representation are presented in (3b) and (3c). In (3b), the three examples in the second column have the sequence of an underlying obstruent plus a lateral within a word, while in the two other examples in the third column a word boundary is posited between the obstruent and the lateral. The examples in (3c) are those where an underlying nasal is immediately followed by a lateral. Again in the first three examples of the second column, the sequence of an underlying nasal and a lateral is included within a word, and in the other two examples the nasal and the lateral are located across the word boundary.

Each test word was recorded both in an isolated form and in a frame sentence. The frame sentence used in this experiment is presented in (4).

(4) frame sentence

ikəsi ------ ipnita. 'This is _____ .'

2.2.2. Subjects and Recording

Two native speakers (one male, one female) of YB participated in the recording. All speakers were born and raised in Yonbyon, China and had spent less than two years in South Korea. Neither had any reported history of either speaking or hearing disorders. They were recorded using a CSL (Computerized Speech Lab) (model 4300B) for PC at 16kHz sampling rate. Before recording, each speaker was asked to read a few randomly chosen test tokens to familiarize themselves with the material. Then they were asked to read each test utterance three times in random order, at a natural, comfortable speed. The test sentences were presented in Korean orthography in random order. The total number of tokens were 228 (19 words x 2 speakers x 2 recording styles x 3 repetitions).

2.2.3. Analysis

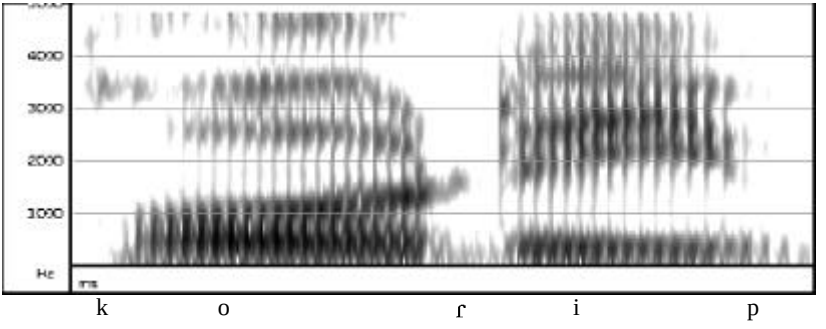
The recorded data were stored as files and then waveforms, and wide-band spectrograms for each token were generated using the MULTI-SPEECH (model 3700) software package. The judgements among various phonetic forms of /l/ were based on the waveforms, spectrograms and recorded sounds. Both authors of this study examined the test tokens for the portion of one repetition by a male speaker and then the second author did the rest of the phonetic analysis based on their judgements of these.

2.3. Results and Discussion

The acoustic data obtained from the experiment conducted in this study were compatible with the impressionistic judgements.

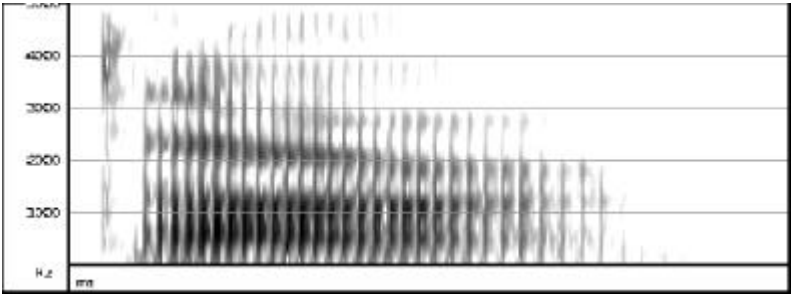
Before reporting how underlying /l/s are phonetically realized in the post-consonantal position, other kinds of lateral variants are examined. First, Figure 1 shows that the underlying /l/s in intervocalic position are realized as "sonorant taps" with rather clear formant patterns, even though they are weaker than those of a vowel. The nature of sonorancy for a tap is also attested in many other languages, including the American English tap (Steriade 2000; de Jong 1998).

Figure 1. /kolip/ --> [koɾip] 'isolation'



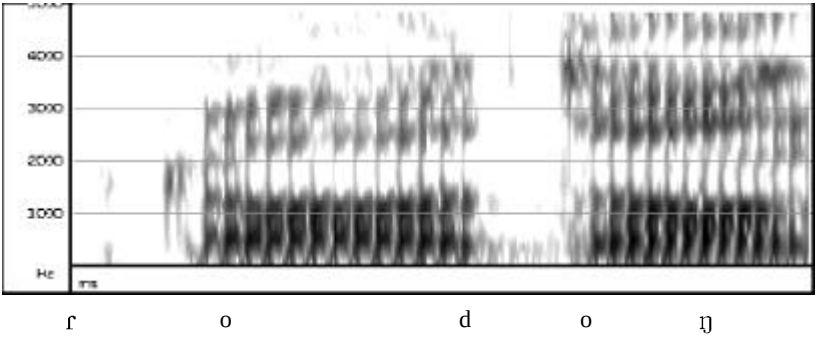
Word-final laterals in YB are also similar to those of SK in that they show clear formant patterns as in Figure 2, but some tokens are heard to be more velarized as in the case of English "dark [l]s". It seems that these lateral variants are produced with greater tongue dorsum retraction and lowering than those in SK laterals. However, the argument for the "darkness" of YB word-final laterals requires more systematic research.

Figure 2. /tol/ --> [tol] 'stone'



t o l

Figure 3. /lotoŋ/ -> [ɾodoŋ] 'labour'



These two different kinds of phonetic realizations of a tap, namely, that in intervocalic position and that in word-initial position, are also found in an experimental study by Lee (1999), where the phonetic realizations of /l/s in Korean loanwords were examined, focusing on their prosodic status. According to her study, intervocalic /l/s are shown to be realized as a sonorant segment with weak formant patterns, while initial /l/s show realization as a short stop or a fricative.[1] Based on these results, she claims that sonorants are observed more often in the prosodically weaker position such as the intervocalic position, while obstruents are more readily found in the prosodically strong position such as the initial position.

Now let us turn to the phonetic realization of underlying laterals after obstruents.[2] First, we consider the various surface realizations of the underlying laterals recorded in an isolated form, which are shown in Table 1.[3]

---

1) Lee's data are much more complex than summarized here, depending on the prosodic position in which each segment occurs. See Lee (1999) for more detailed analysis.

2) Obstruents in front of underlying laterals surface as nasals in this experiment.

3) Some tokens show both weak formant pattern and closure with a strong release. This partially nasalized pattern is classified as "nasalized tap".

Table 1. Various phonetic realizations of /l/ after obstruents in isolated forms (number of tokens)

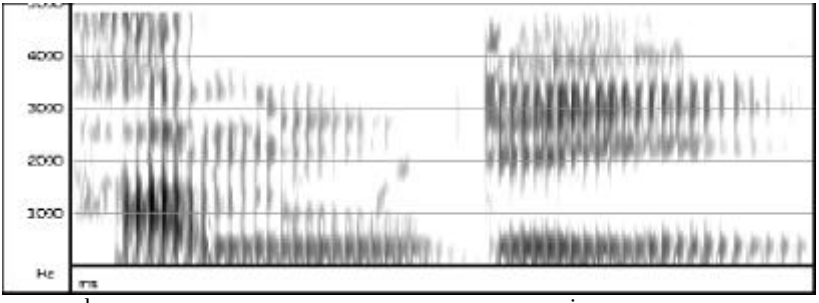
prosodic context	nasal	lateral	tap	nasalized tap	sum
[...C__...]$_{word}$	0	0	26	1	27
C]$_{word}$ _____	1	1	13	3	18
sum	1	1	39	4	45

(C=consonant)

Table 1 shows that most underlying laterals are realized as a tap or a nasalized tap (43 tokens out of 45), which appear to be similar to stops with a very short closure and a strong release. Some surface taps also show a short period of frication noise. The phonological environment is not shown to affect the phonetic realization of /l/s: whether the sequence of /obstruent+lateral/ in underlying representation is included within a word or separated across the word boundary, laterals surface as a tap in most cases. As we see in Table 1, underlying post-consonantal laterals surface as taps both in word-internal position and across the word boundary.[4] Figure 4 and Figure 5 show the pattern where an underlying /l/ is realized as a tap in word-internal position (/hapli/) and that across the word boundary (/tapsip#li/), respectively. Note that obstruents preceding the underlying laterals always surface as nasals.

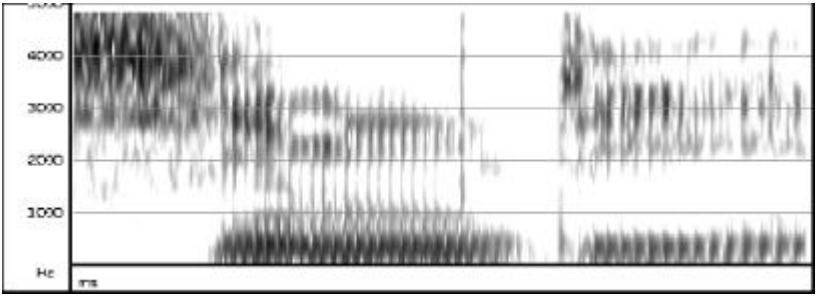
4) Two word tokens out of 45 surface as nasals, but even in these cases we can hear and see the strong release at the beginning of the nasal, which can indicate the onset of the second nasal clearly.

Figure 4. /hapli/ --> [hamɾi] 'reasonableness'



h a m ɾ i

Figure 5. /tapsip#li/ --> [tapsimɾi]



s i m ɾ i

The surface realization of /l/s in post-consonantal position is clearly distinguished from that of intervocalic /l/s or that of word-initial /l/s, even though they are all called as "tap". In Figure 1, we already showed that the intervocalic tap has a clear formant pattern, representing sonorancy. However, the spectrographic data of the post-consonantal taps as given in Figures 4 and 5 reveal that they are not sonorant, but rather a very short voiced stop, which is thus more similar to the word-initial tap. The proper characterization of these two or three kinds of variants of a tap seems to require a finer distinction, depending on their phonological position (and their prosodic position, as suggested in Lee 1999).

The surface realization of laterals following obstruents recorded in a frame sentence is shown in Table 2.

Table 2. Various phonetic realizations of /l/ after an obstruent in a sentence (number of tokens)

prosodic context	nasal	lateral	tap	nasalized tap	sum
[...C__...]$_{word}$	3	0	19	5	27
C]$_{word}$ _____	1	1	14	2	18
sum	4	1	33	7	45

Table 2 shows that even in a frame sentence, underlying laterals are realized as taps or nasalized taps in 92% of tokens. Thus recording style does not affect the realization of underlying /l/s as taps.

Now we consider the realization of the underlying /l/s after an underlying alveolar nasal, which is provided in Table 3 and Table 4. Table 3 is for laterals recorded in isolated forms and Table 4 for those in a frame sentence.

Table 3. Various phonetic realizations of /l/ after nasals in isolated forms (number of tokens)

prosodic context	nasal	lateral	tap	nasalized tap	sum
[...N__...]$_{word}$	0	10	16	1	27
N]$_{word}$ _____	0	0	13	5	18
sum	0	10	29	6	45

(N=nasal)

In SK, the sequence of an underlying alveolar nasal and a lateral within a word is realized as a lateral geminate. However, even in this case, YB produces an interesting form on the surface: a tap preceded

by a nasal [n]. Table 3 shows that more than half of the tokens are shown to be taps, namely, short voiced stops.

It might be noticed that still a considerable number of underlying alveolar nasal-lateral sequences surface as lateral geminates, not as an alveolar nasal plus a tap sequence. We suspect that it has to do with avoidance of the consecutive coronal gestures. A tap is defined as having a certain part of the tongue strike against the roof of the mouth and then return to its rest position. The movement of the tongue tip toward the alveolar ridge is crucial for the successful tap gesture. However, if coronal alveolar contact which is for the alveolar nasal, /n/, is immediately before the tap, the tongue will tend to economically maintain the alveolar contact it began during the /n/, rather than a nasal and a tap. This blocks the occurrence of tap in this environment; instead lateral geminates occur. Similar avoidance of the consecutive coronal gestures is also found in English. Banner-Inouye (1995) notes that in the word 'international', for example, /t/ in the /nt/ sequence is not realized as tap because the tongue tends to economically maintain the alveolar contact it began during the /n/, rather than strike against the roof of the mouth and then return to its rest position.

As for the recording style effect, the frame sentence affects the pattern of the lateral realizations as in Table 4. Fewer taps are shown to occur on the surface of the frame sentence.

Table 4. Various phonetic realizations of /l/ after nasals in a frame sentence (number of tokens)

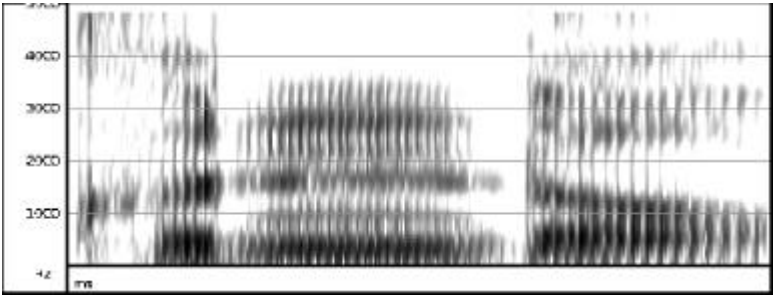
prosodic context	nasal	lateral	tap	nasalized tap	sum
[...N__...]$_{word}$	1	19	6	1	27
N]$_{word}$ _____	0	2	15	1	18
sum	1	21	21	2	45

In word-internal position, seven tokens out of 27 are realized as taps.

19 tokens appear as lateral geminates on the surface. When the word boundary is posited between the nasal and the lateral, most tokens are realized as taps (16 out of 18). We conclude that /l/ does not necessarily become [ɾ] in /n+l/ sequence due to the preceding alveolar sound.

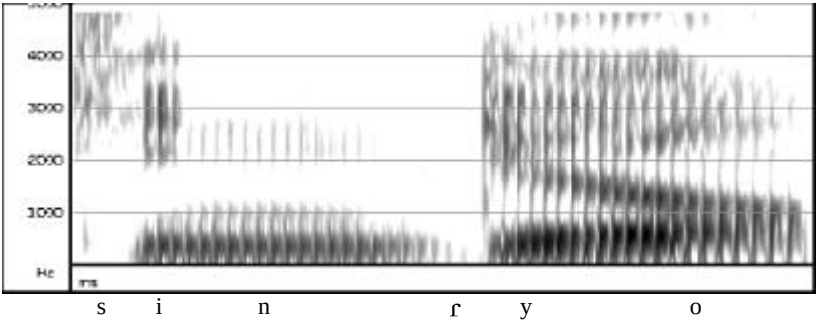
The surface realizations of the laterals after an alveolar nasal [n] as taps word-internally and "across the word boundary" are shown in Figure 6 and 7 respectively.

Figure 6. /kɨnlo/ --> [kɨnɾo] 'work'



k ɨ n ɾ o

Figure 7. /hyaŋsin#lyo/ --> [hyaŋsinɾyo] 'spice'



s i n ɾ y o

From the acoustic data presented in this study, we can conclude that in YB, 1) the obstruent preceding the underlying lateral surfaces as a

nasal; 2) the underlying /l/ surfaces as a tap, not a nasal. This surface tap shows no sonorancy, but rather appears as an obstruent. It is also noteworthy that the obstruent tap occurs in phonologically strong positions, namely, word-initial and post-consonantal. In the following section, we consider what motivates /obstruent+lateral/ to surface as [nasal+tap], not [nasal+nasal].

3. An Optimality-theoretic account of Yonbyon /l/

In this section, we will account for the surface realization of /obstruent+lateral/ in YB within the framework of Optimality Theory and Correspondence Theory (McCarthy & Prince 1993, 1995 etc.).

3.1. Liquids in Yonbyon Dialect

Various alternation forms of underlying /l/ are rewritten in (5) for ease of reference.

(5)	a. yulæ	[yuɾæ]	'origin'
	b. tallyək	[tallyək]	'calendar'
	c. tol	[tol]	'stone'
	d. kyəklyə	[kyəŋɾyə]	'encouragement'
	e. lotoŋ	[ɾodoŋ]	'labor'

As we see in (5a), a lateral appears as sonorant tap [ɾ] in intervocalic position (cf. Figure 1). As a part of a geminate or in coda position, it appears as [l] as in (5b,c). If it appears after a consonant as in (5d) or at the initial position as in (5e), it appears as (obstruent) tap [ɾ]. Interestingly, if an obstruent precedes a lateral in the input, it appears as a nasal as we see in (5d): /k/ changes into /ŋ/ before a surface tap [ɾ]. We suggest that an underlying lateral in (5d) triggers the nasalization of a preceding obstruent, though it appears as tap [ɾ] in the output. We suggest the following constraints (cf. Cho 1997, Davis &

Shin 1999).

(6) a. *ɾ: A tap [ɾ] may not appear.
b. $*_{syl}$[l : A singleton lateral is not licensed as an onset.
c. Max[+son]: A [+sonorant] feature in the input should appear in the output.
d. Ident-Onset[sonorant]: The [±sonorant] feature of an output onset is identical to the [±sonorant] feature of the corresponding input segment.
e. Ident-Onset[nasal]: The [nasal] feature of an output onset is identical to the [nasal] feature of the corresponding input segment.

A few words are in order for the constraints. First, we assume that tap [ɾ] is a member of rhotics (7) (cf. Ladefoged & Maddieson 1990) and that the exact phonetic nature of tap [ɾ] in Korean depends on phonological environments. For example, in a lenition environment, it is usually realized as sonorant tap whereas after a consonant or in the initial position, it is usually realized as tap with a short stop duration.

(7) Rhotics (r-sounds) are "segments in which there is a single or repeated brief contact between the tongue and a point on the upper surface of the vocal tract, i.e. principally apical trills, taps and flaps." (Ladefoged & Maddieson 1990: 182)

Now, let us begin to investigate how each of the surface forms of an input /l/ is selected. First, consider laterals in intervocalic position as in (8).

(8) /yu+læ/ --> [yuɾæ] 'origin'

/yu+læ/	*syl[l	Ident -Onset[nas]	Max [lat]
a. yu.læ	*!		
☞ b. yu.ɾæ			*
c. yu.næ		*!	*

As we see in (8), the constraint ranking in (8) will select the correct output /yu.ɾæ/. Candidate (a) violates the fatal *syl[l and candidate (c) violates fatal Ident-Onset[nas]. On the other hand, candidate (b) violates only Max[lat], the lowest-ranking among the relevant constraints. Therefore, /yu.ɾæ/ is selected as optimal.

If an /l/-initial morpheme is attached to an obstruent-ending morpheme, the following constraint tableau will occur.

(9) /kyək+lyə/ --> [kyəŋɾyə] 'encouragement'

/kyək+lyə/	*syl[l	Ident-Onset[nas]	Max [son]	*ɾ	Faith (coda)
a. kyəklyə	*!				
b. kyəŋnyə		*!			*
☞ c. kyəŋɾyə				*	*
d. kyəkɾyə			*!	*	

The most faithful candidate, (a), violates an undominated constraint *syl[l and thus is eliminated. Candidate (b) violates another fatal constraint Ident-Onset[nasal]. Candidates (c) and (d) both respect Ident-Onset[nasal] but incur a violation of *ɾ. Between candidates (c) and (d), candidate (d) respects Faith (Coda)[5] but violates constraint Max[son] since an input /l/ is realized as a short obstruent [ɾ] and its underlying [sonorant] feature is never realized either on the segment itself or on the adjacent segment [k]. On the other hand, candidate (c)

5) Faith(Coda) says that a coda segment should be faithful to the corresponding input segment.

violates Faith(Coda) but respects Max[son] since [+son] feature of an input [l] is realized on the preceding segment. Since the optimal output is candidate (c), [kyəŋɾyə], Max[son] should outrank Faith(Coda).

However, the constraint ranking in (9) cannot eliminate a possible candidate, [kyəŋtyə], as an optimal output. Consider (10).

(10)

/kyək+lyə/	SyllCon $*_{syl}$[l	Ident-Onset[nas]	Max [son]	*ɾ
a. kyəŋɾyə				*
b. kyəŋtyə				

Note that /kyəŋtyə/ (b) does not violate any of the constraints given in (10) and thus it should be selected as optimal. The difference between two candidates in (10) is that the input /l/ appears as a tap in (a) whereas it appears as an obstruent [t] in (b). However, this difference cannot be captured with any of the constraints in (6). Then what constraint(s) dictates candidate (a) to be an optimal one when compared with candidate (b)? Though 'encouragement' in (10b) is represented as /kyəŋtyə/, [t] in [kyəŋtyə] is very likely to be pronounced as [d] by voicing assimilation in Korean and thus, [voice] cannot be a feature which distinguishes [t] from [ɾ]. Therefore, feature-wise, tap [ɾ] seems to be as different from an input [l] as [t] is. Note that phonetically [t] is an obstruent stop and [ɾ] is an obstruent stop as well in this position. The difference is that the duration of closure in tap [ɾ] is shorter than that of the obstruent [t]. Thus, faithfulness constraints between input [l] and outputs [ɾ] and [t] do not seem to help us select the correct output (a).

It is possible, of course, that by ranking some markedness constraints like *t >> *ɾ, we can select the correct output as is shown in (11).

(11)

/kyək+lyə/	*ɾ]$_{syl}$	Ident-Onset	*t	*ɾ
	*$_{syl}$[l	[nas]		
☞ a. kyəŋɾyə				*
b. kyəŋtyə			*!	

Since *t is more highly ranked than *ɾ, /kyəŋtyə/ which violates *t will be eliminated and /kyəŋɾyə/ in (11b) will be selected as optimal.

However, it has been argued that for South Korean dialect [t] is the most unmarked consonant (cf. Sohn 1987, etc.) and as far as we know, there is no argument against the unmarked nature of [t] in the Yonbyon dialect, either. Therefore, ranking *ɾ the lowest contradicts this assumption, namely that [t] is the most unmarked consonant in Korean. We conclude that neither faithfulness constraints nor markedness constraints help us select the correct output in (11).

3.2. Some Argument for a feature [liquid]

In this subsection, we will offer the suggestion why tap [ɾ], not [t], is preferred as an allophone of /l/ in the postconsonantal position. We propose that a tap [ɾ] appears in YB since [ɾ] shares some phonetic features with [l]. We suggest that the shared feature between these two categories is [liquid] in (12). With the feature [liquid], the close relationship between [l] and [ɾ] can be easily defined. Consider the constraint tableau in (13).

(12) [liquid]: Certain phonetic and phonological similarities which laterals and taps (more generally, rhotics) share (Ladefoged & Maddieson 1990).

(13) /kyək+lyə/ - - > [kyəŋɾyə] 'encouragement'

/kyək+lyə/	*syl[l	Max[liquid]	Max [son]	*ɾ	Faith (coda)
☞ a. kyəŋɾyə				*	*
b. kyəŋtyə		*!			

Candidate (b) violates Max[liquid] and candidate (a) violates *ɾ. Since *ɾ is ranked lower than Max[liquid], /kyəŋɾyə/ is selected as optimal.

The ranking between Max[liquid] and Max[son] can be determined if we examine examples with word-initial /l/. Consider (14).

(14)

/lo+doŋ/	*syl[l	Max[liquid]	Max [son]	*ɾ	Faith (coda)
a. lodoŋ	*!				
b. nodoŋ		*!			
☞ c. ɾodoŋ			*	*	

Candidate (a) violates an undominated constraint *syl[l. Candidate (b) incurs a violation of Max[liquid] since an underlyingly distinctive segment is neutralized as [n] on the surface. Candidate (c), however, violates Max[son] since an underlying [sonorant] feature is not realized either on the segment itself or on a nearby segment in the output. Since candidate [ɾodoŋ] is optimal, Max[liquid] should be ranked higher than Max[son] in YB. By adopting a feature [liquid], we are able to explain the surface alternation forms of /l/ in YB.

4. Conclusion

In this paper, we have considered an optimality-theoretic account for the surface forms of liquid in Yonbyon Korean. In specific, we have shown that a liquid appears as tap [ɾ] in postconsonantal and word-initial positions in YB due to the constraint ranking in (15). We

have also shown that pre-liquid obstruent surfaces as nasal due to the underlying [sonorant] feature of an input liquid.

(15) YB: $*_{syl}$[l >> Max[liquid] >> Ident-Onset[son] >> *Cɾ, *##ɾ, *ɾ

References

Banner-Inouye, S. (1995). *Trills, taps and stops in contrast and variation*. Unpublished doctoral dissertation. UCLA. Los Angeles, CA.

Catford, J. (1988). *A Practical Introduction to Phonetics*. Clarendon Press: Oxford.

Cho, Y. (1997). Liquid specification in Korean as geminate alterability. *Harvard Studies in Korean Linguistics VII*, 78-92.

Davis, S. & S.-H. Shin. (1999). The syllable contact constraint in Korean: An optimality-theoretic analysis. *Journal of East Asian Linguistics 8:4*, 285-312.

de Jong, K. (1998). Stress-related variation in the articulation of coda alveolar stops: flapping revisited. *Journal of Phonetics 26*, 283-310.

Jun, J. (2000). Preliquid nasalization. *Korean Journal of Linguistics* 25:2, 191-208.

Kahn, D. (1976). *Syllable-based generalizations in English phonology*. Unpublished doctoral dissertation. MIT. Boston, MA.

Kim-Renaud, Y-K. (1974). *Korean consonantal phonology*, Unpublished doctoral dissertation. University of Hawaii. Manoa, Hawaii.

Ladefoged, P. (1993). *A Course in Phonetics*. New York: Harcourt, Brace, Jovanovich.

Ladefoged, P. & Maddieson. A (1990). *The Sounds of the World's Languages*. Blackwell, Oxford.

Lee, S.-H. (1999). On the relationship between the phonetic realizations of the allophones of the Korean liquid /l/ and their prosodic status. *The Journal of the Acoustical Society of Korea 18:7*, 85-91.

McCarthy, J. & Prince, A. (1993). *Prosodic Morphology I: Constraint Interaction and Satisfaction*. Unpublished manuscript.

McCarthy, J. & Prince, A (1995). Faithfulness and reduplicative identity. *University of Massachusetts Occasional papers in Linguistics: Papers in Optimality Theory*, 249-384. Amherst: GLSA.

Steriade, D. (2000). Paradigm uniformity and the phonetics-phonological boundary. *Papers in Laboratory Phonology V*, 300-313.

Hyunsook Kang
English Language and Culture Division
Hanyang University
Sa-dong, Ansan-si
Kyungki-do 425-791, Korea
Phone: 82-31-400-5348
E-mail: hskang@hanyang.ac.kr

Jeong-Im Han
Department of English, Konkuk University
Hwayang-dong 1, Gwangjin-gu
Seoul 143-701, Korea
Phone: 82-2-450-3339
E-mail: jhan@konkuk.ac.kr

Received in September, 2002
Accepted in November, 2002