

The phonetics and phonology of emphatic reduplication: A case study of Jeju Korean*

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Kang, Seokhan. 2013. The phonetics and phonology of emphatic reduplication: A case study of Jeju Korean. *Studies in Phonetics, Phonology and Morphology*. 19.1. 3-32. Reduplication patterns of Jeju and Seoul Korean are noteworthy in that they are similar but still distinct in both quality and quantity. The emphatic forms of Jeju Korean pursue the identity avoidance between base and reduplicant in a reduplicative template, through alternating vowels, consonants, and features. The identity avoidance is created by the cooperation of universal grammar of perception and localized grammar of production. This process of negotiation between two grammars is motivated in forming emphatic reduplication of Jeju Korean. The motivation should be considered as the interface between production and perception, in which the perceptual distance such as maximizing differences of formant, duration, and F0 triggers particular phonotactic grammars such as raising and fronting in vowels as well as deletion, addition, tensification, and aspiration in consonants. (Seoul National University)

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1. Introduction

Reduplication copies base from input to the reduplicant with segments (consonants or vowels) or prosodic units (syllables or moras), leading to both strings of morphological and phonological units that are the lexical realization of reduplicative morphemes. Thus, reduplication is described as the repetition of morphological constituents such as words, stems, or roots as well as phonological units such as syllables, tone, or rhythm. It means that forming the reduplicative words could be motivated in the interface between phonology and morphology.

Despite the formalists' approach to the morphological-oriented explanation on reduplication, some research considers the interface between phonology and phonetics (e.g., Steriade 1995, 1997, Flemming 1996, 2005, Wright 2001). They suggested that phonological or morphological grammar could be triggered primarily by perceptual contrasts and then formed by production rules. For instance, Flemming (1996, 2005) suggested that the well-formedness of phonological contrasts is set up based on the dispersion theory that requires maximizing the number of contrasts and their

* A considerable amount of revision has been conducted after the first screen. I really appreciate chief-editor and three anonymous reviewers. In 2011, Jeju Korean was entitled as 'Critically Endangered Language' by UNESCO. It's my pleasure to have a chance to study this disappearing language as a native Jeju Korean speaker.

distinctiveness. He argued that selecting phonological contrasts is to be subject to three functional goals: maximizing the number of contrasts, maximizing the distinctiveness of contrasts, and minimizing articulatory effort. The constraints on the well-formedness of contrasts lead to the optimal sound alternation.

Some research tries to adopt the perceptual aspect in explaining the reduplication. It is suggested that the reduplication in some languages is triggered by the perceptual contrast (e.g., Wedel 2000, Urbanczyk 2005, Dhillon 2007), but the phonological contrast is differently realized depending on the specific languages (Urbanczyk 2005, Kang 2008, Kang and Rhee 2009). Urbanczyk (2005) suggested that Turkish emphatic reduplication should be explained in the context of the relationship between phonology and perception, in which the perceptual contrast triggers identical-avoidance forms in Turkish reduplication. Kang (2008) reported that the partial reduplication of English is highly motivated by the interface between the two. He argued that the partial reduplication of English is triggered by the perceptual difference of some prominent acoustic cues such as noise and transition in temporal properties as well as F1 and F2 in spectral features, even though the alternation forms differently depending on whether it is rhyme or ablaut reduplication. Furthermore, this tendency of asymmetrical distribution leads to identity avoidance of melody which exhibits the syllable sequences of ‘ø – C’ between base and reduplicant for the maximal perceptual difference (ex. *airy-fairy*).

To date, the study of Jeju Korean emphatic reduplication tends to describe its phenomena as ‘emphatic sound feeling’. Some researchers (e.g., Lee 1982, Kang 1986) classified the emphatic forms into 40 classes of contrast pairs such as /ʌ:/i/, /ʌ:/e/, /o:/i/, etc, claiming that vowel alternation could be explained as the contrast of weak sound feeling versus strong sound feeling. Kang and Rhee (2009) criticize the previous research, claiming that the emphatic repeating adverb should be explained as a form of perceptual contrast. However, these studies have focused only on the vowel emphatic forms, implying that the consonantal alternation is totally different phenomenon.

This paper claims that emphatic forms appeared in Jeju Korean pursue the unique goal of perceptual difference, regardless of vowel or consonantal alternation. The initial reduplication is triggered by pure morphological motivation in repeating the base in output. Successive emphatic reduplication, however, is carried out by non-morphological motivation which is closely tied with the perceptual contrast of melody. More specifically, post-morphological reduplication in Jeju Korean is controlled by perceptual principle – maximizing the contrast, but the specific grammar of production is realized by localized phonotactic rules which lead to deletion, addition, tensification, and aspiration in consonants as well as fronting and raising in vowels. The paper presents evidence that emphatic reduplication, either vowel or consonantal alternation, should be considered under the perceptual

principles of melody.

2. Emphatic reduplication in Jeju Korean

Jeju Korean, a dialect of the Korean language, has 19 consonants, in which it shares similar structure with the standard Seoul Korean. However, the vowel inventory of Jeju Korean is slightly different from that of Seoul Korean. Seoul Korean has 7 vowels, in which sound change occurs rapidly; Seoul Korean had 8 vowels in 1960s and 7 vowels in 1990s, while Jeju Korean had 9 vowels in 1960s and 7 vowels in 1990s (or 8 vowels for rural speakers).

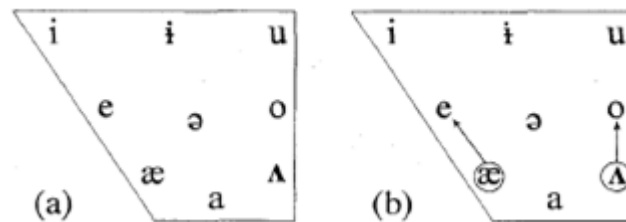


Figure 1. Two vowel system in Jeju Korean: (a) 9 vowel system in old generation, (b) 7 vowel system in younger generation (Cho et al. 2000:81).

Figure 1 reports that the vowel speech of the younger generation merges /æ/ into /e/ along with /ʌ/ into /o/. On the contrary, consonantal change hardly occurs recently. Some researchers (e.g., Cheong 1996, Cho et al. 2002) reported that the consonantal difference of the acoustical properties between Jeju and Seoul Korean is not significantly different. In spite of the structural similarity between two areas of Koreans, Jeju Korean still holds the unique position in the Korean language since it keeps comparatively large amounts of the archaic language forms of Middle Korean during 15th to 16th century. Recently Jeju Korean was entitled to ‘Critically Endangered Language’ by UNESCO in 2011 because the language users were no more than 10,000.

Emphatic reduplications in Jeju Korean have distinctive forms different from Seoul Korean which has few emphatic forms. Following is an example of reduplication appeared in Jeju Korean.

(1) Reduplication in Jeju Korean (Song 2007)

<i>tung.kul.ta</i> (or <i>tung.kil.ta</i>)	verb-like adverb + suffix. ‘It is rounding.’
<i>tung.kul.tung.kul</i>	simple reduplication
<i>tong.ol.tong.ol</i>	weakening form: k-deletion

<i>tong.kol.tong.kol</i>	emphatic form: vowel alternation
<i>tong.k^hol.tong.k^hol</i>	emphatic form: aspiration
<i>tong.k^hol.lak.tong.k^hol.lak</i>	emphatic form: syllable addition

The repetitive adverb ‘*tong.kol.tong.kol.*’ meaning ‘round’ has various emphatic forms using phoneme alternation. The repetitive adverb of ‘*tong.ol.tong.ol*’ derived from ‘*tong.kol.tong.kol*’ through consonantal deletion has a weak meaning as ‘small rounding’ for something, while ‘*tong.k^hol.tong.k^hol.*’ or ‘*tong.k^hol.lak.tong.k^hol.lak.*’ through consonantal or syllable addition has a strong meaning of ‘big rounding’. For example, the sentence of ‘*tol.i.tong.kol.tong.kol.ha.ta.*’ refers to ‘the stone is little rounding’, whereas the sentence, ‘*tol.i.tong.k^hol.lak.tong.k^hol.lak.ha.ta.*’, means ‘the stone is really rounding and rounding.’

Generally, Jeju Korean has two types of reduplication in the first output: the partial (e.g., *pə.t^hik* → *pə.t^hi.tik*), and the total reduplication (e.g., *cul.lak* → *cul.lak.cul.lak*). In most cases, the emphatic forms originate from the total reduplication. The common form of the total reduplication is a quart-syllabic template consisting of bi-syllables of the base and bi-syllables of reduplicant, though some compose more than (or less than) bi-syllables: mono-syllable or tri-syllable (e.g., *c’ak.c’ak*, or *keng.kil.lang.keng.kil.lang*).

After the first morphological reduplication, the successive reduplication of Jeju Korean has various alternations in its emphatic forms: vowel change (e.g., *pa.kak.pa.kak* → *po.kak.po.kak*), consonantal change (*pu.sa.pu.sak* → *p^hu.sak.p^hu.sak*), or co-change of vowel and consonants (*pang.us.pang.us* → *pang.kus.pang.kus*). Large amounts of variations occur in the vowels rather than in consonants or co-change in both vowels and consonants. In the consonant-related change, the pure consonantal changes occur as a form of consonantal deletion or addition, while the feature changes exist as a form of aspiration or tensification.

3. The formation of emphatic reduplication

Alternative reduplication implies asymmetrical phoneme coordination between original and alternated phonemes through input and output, or output and output. Depending on the relationship between input and output, or output and output, Kang and Rhee (2009) classify the reduplication into three types universally: (a) the groups of same I(nput)-B(ase) and different B(ase)-R(eduplicant), (b) of different I-B and same B-R, and (c) of different I-B, different I-R, and same B-R.

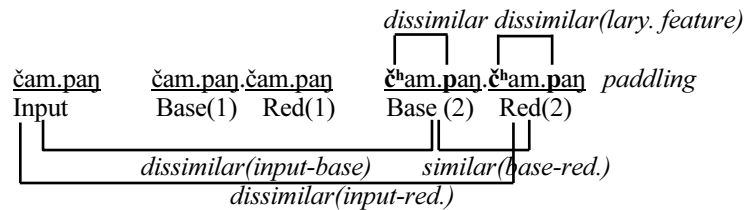
(2) The models of alternative reduplication (Kang and Rhee: 426)

a. B	≠	R	b. B	=	R	c. B	=	R
			‡			‡		‡
I			I			I		I

*I: input. B: base. R: reduplicant.

By following this model, (a) represents a typical partial reduplication (e.g., Turkish by Dhillon 2007, Korean by Chae 1987, 2003, Jun and Lee 2006) and (b) is a total reduplication controlled by phonological rules (e.g., Javanese by Inkelas 2008), while (c) represents emphatic reduplication. Emphatic forms, including Jeju Korean reduplication, tends to follow the cases of different I-B, different I-R, and similar O2-O2 (similar phonemes in second reduplication) because of dissimilarity between input and base, or input and reduplicant.

(3) Structure of emphatic forms



Generally, alternative reduplication expresses the asymmetrical relationship between the first and second syllable in both base and reduplicant, violating the I-O Identity (Input-Output Identity). The alternative reduplication implies OCP effect between two syllables in an outputted template. Jun and Lee (2006) reported that Korean partial reduplication is occurred by high ranked OCP and some PHON constraints along with morphological constraint of CONTIG. On the contrary, the emphatic forms appeared in Jeju Korean show slightly different sound coordination between input and base, along with the asymmetrical coordination between base and reduplicant in each output level. More specifically, sound strengthening between input and output keeps the OCP rule in an outputted template.

Sound strengthening occurs between input and base (ex. *čam.pan* → *čʰam.pan*), in which plain affricative /č/ coordinates with aspirated affricative /čʰ/. This coordination is closely controlled by OCP which deploys feature coordination between base and reduplicant, in which the aspirated obstruent /čʰ/ in the first syllable coordinates with the plain obstruent /p/ in the second syllable of the reduplicant '*čʰam.pan*', keeping the morphological symmetry

between base and reduplicant as seen in ‘*č^ham.paŋ.č^ham.paŋ*’.

Even though they have same morphological copy between input and reduplicant, their phonological coordination favors different properties between the first and second syllable. Thus, OCP occurred in the emphatic forms of Jeju Korean is totally different phenomenon from output-output OCP between input and base, or input and reduplicant, leading to the asymmetrically phonological coordination. The concern of the paper focuses on the internal sound strengthening, leading to the OCP phenomenon in output.

Even though a small amount of similar data could be found in Seoul Korean, emphatic reduplication in Jeju Korean shows a much richer phenomenon than the one in Seoul Korean. Through the prior research (Kang and Rhee 2009), 2321 reduplications have been found in both Koreans, in which the numbers of reduplications are more frequent in Jeju Korean (1788) than in Seoul Korean (533). 74 % of 1788 reduplications in Jeju Korean have emphatic forms, while only 43% of 533 reduplications in Seoul Korean have the counterparts. It means that they have different frequencies in emphatic forms. Furthermore, in Jeju Korean, the reduplication with one-time emphatic forms occupies 71% along with 17% of two-time emphatic form, 6% of three-time form, and 3 % of even four or five-time forms, while Seoul Korean has 80% of one-time form and 18% of two-time form. Accordingly, it is safe to say that emphatic forms are much richer in Jeju Korean than in Seoul Korean. While Seoul Korean achieves its emphatic form through alternating the phonemes regardless of the syllable placement on whether it is penult or ultima, Jeju Korean follows some specific rules on vowel heightening or fronting as well as consonantal addition, deletion, tensification, and aspiration. Following figures show the acoustic properties of the emphatic forms.

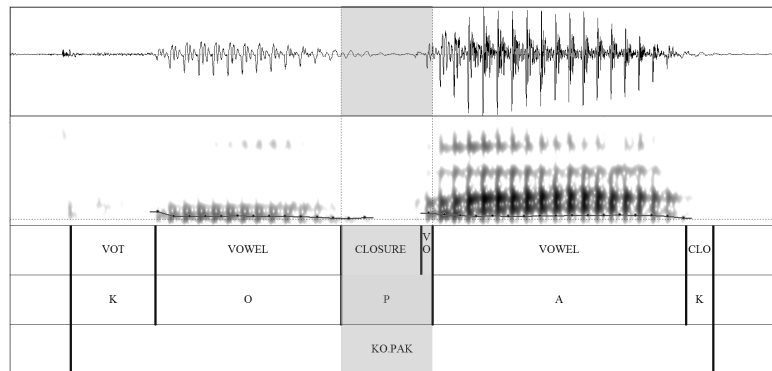


Figure 2. Acoustic cues in ‘*ko.pak*’ of ‘*ko.pak.ko.pak*’ as a simple reduplication

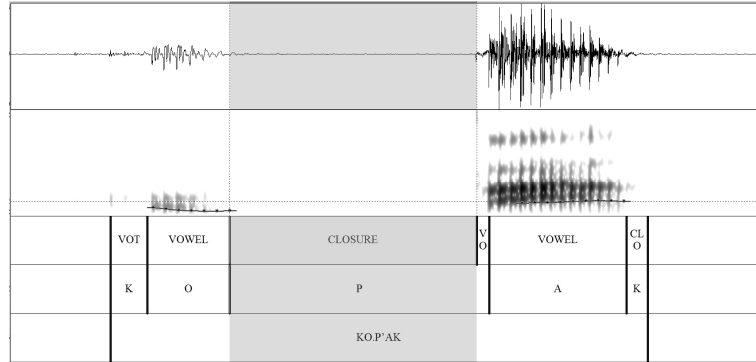


Figure 3. Acoustic cues in 'ko.p'ak' of 'ko.p'ak.ko.p'ak' as an emphatic reduplication

In Figure 2, the plain stop 'p' in the second syllable of 'ko.pak' shows voicing cues in the intervocal position: voicing during closure, short closure duration, and F0 appearance. On the contrary, as you see in Figure 3, the stop 'p' in the second syllable of 'ko.p'ak' shows tensified cues: silence during stop closure, longer closure duration, and no F0 in the duration. It means that plain stops exert totally different acoustic cues from tense stops.

The aim of the paper presented here is to claim that emphatic reduplication in Jeju Korean pursues the maximum perceptual distance of melody. To prove the argument, this study analyzes the acoustic data of the multi-variable emphatic reduplications in Jeju Korean. The organization of this paper is as follows: in the next section 4, the production experiment was analyzed by following three categories of consonantal, feature, and vowel alternation. Section 5 discusses process and direction of the variables which occupies emphatic reduplication from the view of phonology. In section 6, it is suggested that emphatic reduplication is the process of negotiation between the universal grammar of perception and the localized grammar of production.

4. Phonetic experiment

4.1 Method

To prove the hypothesis of phonetic distance for the emphatic forms, the speech of sound alternations was investigated. The data were collected from native Jeju Korean speakers' production in both input and output (base/reduplicant). The aim of the phonetic experiment is to investigate the acoustic properties for the target sounds. This experiment could be essential evidence for the phonological grammars such as consonantal addition and deletion, tensification, and aspiration as well as vowel raising and fronting.

Five adult male participants who were born and grown up in Jeju Island

were participated. None reported being diagnosed with a language or speech disorder. Their mean age is 42.1 (standard deviation = 3.5) years and mean years of schooling is 10.3 years (standard deviation = 2.1), in which they almost had grown up till the universities in Jeju island. They use Jeju dialect of Korean predominately in their homes (72%) rather than in work places (28%), even though they could speak both Jeju and standard Seoul Korean.

All participants were recorded reading 60 simple and emphatic reduplications which are embedded in the set of '*i kəsin* _____ *lako hanta*' (we call it _____). Each participant was asked to read each sentence three times, but the second reading was analyzed. Before they produced the sentences, it was confirmed that they knew what the sentences meant, and that they knew how to pronounce them. The sounds were recorded with a Marantz PMD 650 using a Shure SM 10A microphone, digitalized at 44.05 kHz and 16 bit resolution.

4.2 Measurements

Fifty-eighty reduplications (see Appendix A) were used to evaluate the acoustic cues. Several acoustic measurements for fundamental frequency (in Hertz) and duration (in milliseconds) in consonantal and feature alternation as well as for the first and second formants (in Hertz) in vowels were made. These acoustic cues were measured using a waveform display with a time-locked wideband spectrogram with the software PRAAT (5.1.17). All acoustic cues were measured from the initial acoustic signal in both the waveform and the spectrogram to the final acoustic cues of the boundary such as burst or spectral cues (Kent and Read 2003, Ladefoged 2001).

These measures were analyzed with independent t-test which was conducted for statistical evaluation of the reduplication groups with the following parameters: dependent variables of fundamental frequency, closure duration, syllable duration, and the first two formants. These cues were examined by the factor of both kinds of forms (input and output forms). The statistical t-test was used in order to investigate the difference of both forms (input and output).

4.3 Results

The results were presented by following 3 classified word groups: consonantal alternation (addition and deletion), feature alternation (aspiration and tensification), and vowel alternation (raising and fronting). Each group was analyzed separately depending on phonological phenomena, comparing both forms of input and output.

4.3.1 Consonantal alternation

It is clear that consonantal alternation is triggered by the durational difference of the syllables between input and base/reduplicant (e.g., *tong.ol.* → *tong.kol.tong.kol.*) Subjects produce longer duration more than 20% in emphatic reduplication. In the experiment, independent t-test conducted for each measured cue shows that the empathic forms using consonantal alternation are greatly related to syllable duration ($t = 60.13, p < .0001$), neither to closure duration ($t = 2.782, p > .05$), nor pitch ($t = 2.125, p > .05$), nor to intensity ($t = 3.786, p > .05$). Mean duration of the emphatic forms is longer than the one of input words: 248 ms vs. 160 ms. Thus, the emphatic forms of the consonantal alternation favor a longer syllable duration.

Table 1. Mean and standard deviation of acoustic cues on consonantal alternation

	Syllable duration(ms)**	Closure duration	Pitch (Hz)	Intensity (dB)
Input	168 (31)	46 (11)	122 (14)	80 (3)
Output(base/red.)	237 (43)	51 (12)	117 (12)	81 (2)

*: $p < .05$, **: $p < .0012$

4.3.2 Feature alternation

4.3.2.1 Tensification

It is clear that tensified alternation leads to contrast in the intensity between the input words and emphatic reduplication (e.g., *tiŋ.kis.* → *tiŋ.k'is.tiŋ.k'is.*). In the experiment, independent t-test conducted for each measured cue shows that the empathic forms are greatly related to closure duration ($t = 72.634, p < .0001$), neither to duration ($t = 0.976, p > .05$), nor to pitch ($t = 3.912, p > .05$), nor to intensity ($t = 3.219, p > .05$). Mean closure duration of the emphatic forms is longer than the simple reduplication: 102 ms vs. 42 ms. Finally the emphatic forms using the tensified alternation produce longer closure duration.

Table 2. Acoustic measurement on tensified emphatic reduplication

	Syllable duration (ms)	Closure duration(ms)**	Pitch (Hz)	Intensity (dB)
Input	152 (23)	43 (11)	127 (11)	80 (1)
Output	147 (19)	105 (23)	133 (9)	82 (2)

*: $p < .05$, **: $p < .001$

4.3.2.2 Aspiration

Feature alternation of the aspirated alternation contrasts the pitch of the syllable between input and emphatic reduplication (e.g., *pu.sak* → *p^hu.sak.p^hu.sak*). In the experiment, independent t-test conducted for each measured cue shows that the emphatic forms are greatly related to pitch, ($t = 27.634$, $p < .0001$) and syllable duration ($t = 8.287$, $p < .05$), nor to closure duration ($t = 3.691$, $p > .05$), nor to intensity ($t = 1.487$, $p > .05$). Mean pitch of the emphatic forms is higher than that of the input words: 143 Hz vs. 121 Hz., along with the meaningful difference of the syllable duration: 254 ms vs. 221 ms. It is clear that the emphatic forms of the aspirated alternation have higher pitch and longer duration.

Table 3. Acoustic measurement on aspirated emphatic reduplication

	Syllable duration(ms)*	Closure duration(ms)	Pitch (Hz)**	Intensity (dB)
Input	219(37)	58 (14)	121 (9)	79 (3)
Output	252(83)	54 (16)	138 (2)	76 (2)

*: $p < .05$, **: $p < .001$

4.3.2 Vowel alternation

Following is mean and standard deviation of vowel measurement shown in simple and emphatic forms.

Table 4. Acoustic measurement on vowel alternation

	F1	F2
[a]	1026.2 (132.6)	1427.8 (128.3)
[e]	632.8 (96.3)	2633.7 (248.1)
[i]	352.7 (61.2)	2587.3 (325.2)
[o]	501.1 (87.8)	876.2 (202.3)
[u]	416.0 (56.4)	952.8 (232.2)

Emphatic forms have wider difference of the first and second formant. In the experiment, independent t-test conducted for each task shows that the emphatic forms are greatly related to the difference of first and second formant ($t = 43.672$, $p < .0001$). Mean difference of the two formants in the emphatic forms is larger than that in the simple reduplication: 926 Hz vs. 472 Hz. It means that vowels in the emphatic forms tend to move front and high as in Table 5.

Table 5. Mean and standard deviation of acoustic measurement on formants difference

	[F2-F1]**
Input	472(67)
Output	926(138)

*: $p < .05$, **: $p < .001$

5. Phonological motivation

Out of 1788 emphatic reduplications in Jeju Korean, emphatic forms of vowel alternation are 1020 (57%) along with consonantal alternations of 362 (20%) including feature alternations, while 406 words are mixed reduplication with vowel and consonantal alternation simultaneously (23%). The study suggests that the phonological motivation in various emphatic forms is triggered by grammar of the perceptual distance; that is, consonantal alternation uses the maximal distance of ‘duration’ between the first and second syllable, while glottal feature alternation pursues the maximal difference of pitch. Furthermore, vowel alternation aims at the maximal difference of the first two formants. Thus, the strategy to increase the semantically emphatic meaning alternates features of the target sound only for one syllable, either first or second syllable. Finally the asymmetrical coordination between input and output causes the localized phonological grammars in Jeju Korean: addition and deletion through consonantal alternation, aspiration and tensification through feature alternation, and raising and fronting through vowel alternation.

5.1 Consonantal alternation

In case of consonantal alternation, the most frequent pairs between base and reduplicant in output are a series of consonant-less onset in the first syllable and obstruent in onset of the second template such as ‘ø:/c, t, p/’ (e.g., *ə.səŋ.pa.səŋ*). Consonantal alternation takes place in two different ways: one is consonantal change such as deletion or addition which alternates the place or manner of consonantal articulation, the other is glottal feature change such as tensification or aspiration which occurs in glottis. I discuss these two alternations in separated sections.

The repetitive adverbs in Jeju Korean express a multi meaning through various productive rules. For example, in (4), the original adverb of ‘*tung.kul.ta*’ creates various emphatic forms meaning ‘round’. The process from ‘*tung.kul.ta*’ to ‘*tung.kul.tung.kul*’ is original reduplication which repeats base, leaving the suffix out. But more developed emphatic forms could be applied to the ‘deletion’, ‘addition’, ‘aspiration’, and ‘syllable copy’, through alternating vowels, consonants, and features.

(4) Emphatic variation

<i>tung.kul.ta</i>	verb-like adverb + suffix
<i>tong.ki.las.ta</i>	verb-like adverb + suffix
<i>tong.kil.tong.kil</i>	base repeat (total reduplication)
<i>tung.kul.tung.kul</i>	base repeat (total reduplication)
<i>tong.kul.tong.kul</i>	vowel alternation
<i>tong.kol.tong.kol</i>	vowel alternation
<i>tong.ol.tong.ol</i>	consonantal deletion
<i>tong.kʰol.tong.kʰol</i>	aspiration (feature change)
<i>tong.kʰol.lak.tong.kʰol.lak</i>	final-syllable copy (syllable addition)

Various emphatic forms keep the grammar of the perceptual distance; that is, consonantal alternation uses the maximal distance of ‘duration’ between the first and second syllable, while glottal feature alternation pursues the maximal difference of pitch and closure duration as seen in the results of speech experiment.

5.1.1 Onset deletion

Consonantal deletion causes the critical impact to listeners through the maximal difference of syllable duration between the first and second syllable, coordinating deleted consonants in the target syllable with undeleted consonants in the other syllable. It includes the pairs of ‘/k/:ø’, ‘/h/:ø’, ‘/p/:ø’ which result from deletion of /k/, /h/, /p/ in input forms.

(5) /k/:ø (k-deletion)

Original input	Base output	
<i>tong.kol.tong.kol</i>	<i>tong.ol.tong.ol</i>	<i>rounding</i>
<i>ko.sil.ko.sil</i>	<i>o.sil.o.sil</i>	<i>properly cooked</i>
<i>pang.kus.pang.kus</i>	<i>pang.us.pang.us</i>	<i>smile</i>
<i>kan.čil.kan.čil</i>	<i>an.čil.an.čil</i>	<i>tickling</i>
<i>kil.kang.kil.kang</i>	<i>il.kang.il.kang</i>	<i>scratching</i>
<i>kwa.lang.kwa.lang</i>	<i>wa.lang.wa.lang</i>	<i>grumble</i>

(6) /h/:ø (h-deletion)

<i>hi.li.ling.hi.li.ling</i>	<i>i.li.ling.i.li.ling</i>	<i>breeze</i>
<i>hə.uk.hə.uk</i>	<i>ə.uk.ə.uk</i>	<i>fast</i>
<i>hu.lak.hu.lak</i>	<i>u.lak.u.lak</i>	<i>hotly</i>

(7) /p/: ø (or j/w) (p-deletion)

pa.sak.pa.sak	wa.sak.wa.sak.	<i>crispy</i>
ča.pul.lak.ča.pul.lak	ča.ul.lak.ča.ul.lak	<i>waddle</i>
wa.sang.pa.sang	wa.sang.wa.sang	<i>boiling</i>

The pairs of ‘/t/:ø’ (ex. *ta.ung.ta.ung* → *a.ung.ta.ung*), ‘/č/:ø’ (ex. *ong.ki.čong.ki* → *ong.ki.ong.ki*, or *čong.ki.čong.ki*), or ‘/s/:ø’ (ex. *əl.kim.səl.kim* → *əl.kim.əl.kim*) can be found in addition to the pairs of ‘/k/:ø’, ‘/h/:ø’, and ‘/p/:ø’. Interestingly, the deletion strategy pursues the perceptual strengthen through the asymmetrical sound coordination between the first and second syllable.

5.1.2 Coda addition

The consonantal segment is added in coda of the first syllable. The outputted reduplicant leads to perceptual contrast between the first and second syllable in base or reduplicant template, lengthening the duration of the target syllable. It is noteworthy that the effect of the perceptual distance can be maximized, considering the relation between input and output as well as between output and output. The alternative patterns include the pairs of ‘ø:/l/’, ‘ø:/m/’, and ‘ø:/p/’ (meaning ‘small’ vs. meaning ‘large’).

(8) ø:/l/

hji.k’ıl.hji.k’ıl	hji.l.k’ıl.hji.l.k’ıl	<i>glancing</i>
hji.t’ak.hji.t’ak	hji.l.t’ak.hji.l.t’ak	<i>fast</i>
t ^h ə.tak.t ^h ə.tak	t ^h əl.tak.t ^h əl.tak	<i>clickety-click</i>
t ^h a.ki.lak.t ^h a.ki.lak	t ^h a.kil.lak.t ^h a.kil.lak	<i>plod</i>
so.lang.so.lang	sol.lang.sol.lang	<i>softly</i>
ča.lak.ča.lak	čal.lak.čal.lak	<i>flowing</i>
mə.s’ık.mə.s’ık	məl.s’ık.məl.s’ık	<i>hesitate</i>
čo.kin.čo.kin	čol.kin.čol.kin	<i>orderly</i>
əl.luk.əl.luk	əl.luk.əl.luk	<i>mottled</i>
tæŋ.ki.laŋ.tæŋ.ki.laŋ	tæŋ.kil.laŋ.tæŋ.kil.laŋ	<i>cling-cling</i>

(9) ø:/m/

kΛ.mak.kΛ.mak	kΛm.mak.kΛm.mak	<i>blink</i>
čΛ.mak.čΛ.mak	čΛm.mak.čΛm.mak	<i>doze</i>
ko.pi.ko.pi	kom.pi.kom.pi	<i>meandering</i>

(10) ø:/p/

ko.pak.ko.pak	kup.pak.kup.pak	<i>nod off</i>
---------------	-----------------	----------------

In most cases, coda addition occurs before sonorants (/l/ and /m/) of the next syllable as a copy form of sonorant. It appears that strategies to lengthen the syllable duration choose the optimal acoustic signals for both listeners and speakers. Speakers can be easy to lengthen the murmur duration because of the adjacent nasal sounds, while listeners feel the extended mora signals because of the lengthened murmur duration. In sum, adding murmur (nasals) or aspiration (stops) in the coda improves the perceptual effect similar to adding one more mora(e) in the syllable.

5.1.3 Principle of consonantal alternation

Perceptual distance between input and base or between input and reduplicant leads to alternation in onset or coda of the target syllable through deletion or addition. In case that the duration in the alternated syllable extends more than 20%, it leads to the asymmetrical comparison of the duration between the first and second syllable (Kang 2008). Note that consonantal alternation favors durational difference through deletion in onset and addition of nasals in coda. Out of 225 pure consonantal emphatic words excluding the feature alternation of 137, significant numbers of emphatic forms favors the specific phonological grammars of consonantal deletion and addition. It appears that consonantal duration in onset and murmur period in coda causes the strong perceptual prominence through the perceptual asymmetry between base and reduplicant. Especially in coda, nasal addition has an impressive perceptual effect in adding a mora because of the longer murmur duration. Thus, the distinction between one mora in base and two morae in reduplicant suggests the effective perceptual comparison. Finally, consonantal alternatives take a strategy to maximize the perceptual prominence through deletion or addition.

5.2 Glottal feature alternation

In addition to the consonantal deletion or addition, the glottal alternation through tensification and aspiration sets up the distinguished emphatic forms in Jeju Korean. The patterns of glottal alternation can be summarized as follows;

Table 6. Consonantal coordination between the first and second syllables

	Simple reduplication	Emphatic reduplication	
	Forms (ex.)	Forms (ex.)	Ratio
T-T'	<i>p_Λ.čak.p_Λ.čak</i>	<i>p_Λ.č'ak.p_Λ.č'ak</i>	30.6
T-T^h	<i>pi.til.pi.til</i>	<i>pi.t^hil.pi.t^hil</i>	12.4
T'-T	<i>čo.kil.čo.kil</i>	<i>č'o.kil.č'o.kil</i>	8.7
T^h-T	<i>pin.čik.pin.čik</i>	<i>p^hin.čik.p^hin.čik</i>	37.2
T^h-T'	X	<i>k^hΛ.č'iŋ.k^hΛ.č'iŋ</i>	10.9
Total			100%

*T: plain obstruents, T': tensified obstruents, T^h: aspirated obstruents, x: not appeared

** T-T: comparison of laryngeal features between the first and second syllable in a template.

Out of 362 of the consonantal emphatic reduplication checked, the numbers of emphatic forms using glottal feature alternation are 137 (38%). The most frequent pattern is the pairs of 'T^h-T' and 'T-T' which require aspiration or tensification in the targeted syllable. Interestingly, aspirated obstruents favor the first syllable, while the tensed obstruents the second syllable. It appears that morphological constraints control the deployment of melodic OCP.

Considering that the numbers of vowel alternation checked in this study are 1020 and consonantal variations are 362, those of glottal feature variations take small shares significantly. It means that perceptual impact is different depending on the alternation types: the strong impact on vowel changes, then consonantal changes, and the least effect on the glottal variations.

In the simple total reduplication, the pairs of 'T'-T^h', 'T'-T', and 'T^h-T^h' are prohibited. In the emphatic forms, even though the pairs of 'T'-T^h' and 'T^h-T^h' are still avoided, the pair of 'T^h-T' can occur. It is noteworthy that the prohibited pairs violate the identity avoidance, but this principle could be applied flexibly in the emphatic forms. It appears that longer syllable duration, a basic cue of emphatic forms, allows the tensed obstruent in the intervocalic position to lead the pair of 'T^h-T' which rarely permitted in the simple reduplication.

In reality, emphatic reduplication permits comparatively wide distribution of laryngeal features, whereas the simple total reduplication narrows down the range of permitted pairs. For example, the total reduplication permits the consonantal pairs of 'plain versus plain (T-T)', 'plain versus tense (T-T')', 'plain versus aspiration (T-T^h)', 'aspiration versus plain (T^h-T)', and 'aspiration versus tense (T^h-T')' between base and reduplicant, while emphatic forms permit even the pair of tense versus aspiration (T'-T^h) which never occurs in the total reduplication (e.g., *čo.kil.čo.kil* → *č'o.k^hil.č'o.k^hil*). In brief, glottal alternation occurs through aspiration and tensification as follows.

(11) Patterns of glottal-alternative emphatic reduplication

Type I: TVT.TVT.TVT.TVT. → TVT.T^hT.TVT.T^hVT.ex. *tal.kak.tal.kak* → *tal.k'ak.tal.k'ak*Type II: TVT.TVT.TVT.TVT. → T^hVT.TVT.T^hVT.TVT.ex. *ku.pak.ku.pak* → *k'u.pak.k'u.pak*Type III: TVT.TVT.TVT.TVT. → T^hVT.TT.T^hVT.T^hVTex. *pin.čik.pin.čik* → *p^hin.č'ik.p^hin.č'ik*

The emphatic forms achieve their enhancement through asymmetrical pairs of glottal features between the first and second syllable in base and reduplicant. It is safe to say that OCP (obligatory contour principle) controls the emphatic forms which require asymmetrical relations between the first and second syllable. Generally the output of OCP does not include the two equal features (e.g., Leben 1973, Goldsmith 1976, McCarthy 1986, 1995, Suzuki 1998, Yip 1998). Boersma (2000) suggested the faithfulness constraint based on perceptual phonetic cues leading to specific productive grammars, adopting the perceptual OCP. Interestingly emphatic reduplication in Jeju Korean allows some prohibited pairs in the simple reduplication, violating the strict OCP rules. The coordination of 'T^h-T' occurs in the emphatic form (ex. *k^hΛ.č'ij.k^hΛ.č'ij*). It appears that lengthened duration of the target syllable permits the banned pairs of aspirated and tensed syllables. Based on the observation, we can predict the order of the emphatic process; that is lengthening of the syllable duration (as a consonantal or syllable addition, or copy) at first and then addition of features (as aspiration and tensification).

In case that no further emphatic forms using consonantal or feature alternation are possible, they choose the vowel variation or syllable copy for the further emphatic forms as follows:

(12) Examples of further emphatic forms

- | | | | |
|----|--|--|--|
| a. | <i>sil.kak.sil.kak</i> | <i>sil.k'ak.sil.k'ak</i> | <i>sil.k'ak.sil.k'ak</i> |
| b. | <i>pi.sil.pi.sil</i> | <i>pi.č^hil.pi.č^hil</i> | <i>pi.č^hil.lak.pi.č^hil.lak</i> |
| | <i>pi.č^hil.ki.lak.pi.č^hil.ki.lak</i> | | <i>pi.č^hil.kil.lak.pi.č^hil.kil.lak</i> |

In (12a), the input of '*sil.kak*' produces the emphatic form of '*sil.k'ak*' through tensification for the second syllable. In case that no further emphatic forms using consonantal or feature alternation are possible (ex. '*sil.k'ak*'), it chooses the vowel alternation from /i/ to /i/ (ex. *sil.k'ak.sil.k'ak* → *sil.k'ak.sil.k'ak*).

The emphatic word of (12b) is one of the extreme cases. The first emphatic forms occur through aspiration of the target syllable (ex. *pi.č^hil*).

pi.č^hil.), and then syllable ‘lak’ addition (ex. *pi.č^hil.lak. pi.č^hil.lak.*). For the syllable ‘lak’, Albright¹ (MIT) thinks of its addition as syllable copy from ‘l’ in the previous syllable. Considering that alternative form ‘lang’ exists along with ‘lak’, there are still some unresolved questions on why only velar stops ‘k’ or ‘ŋ’ occurs in coda. Also another syllable of ‘ki’ adds before ‘lak’. More importantly, ‘ki’ can be added only after ‘lak’ adds. Finally the added syllable of ‘ki’ can be strengthened through adding ‘l’ so that ‘kil’ produces.

5.2.1 Tensification

Tensification occurs in either the first or second syllable in reduplicant. Either way, plain stops or affricates become tensified, adding the laryngeal feature of [+tense] in reduplicant and keeping the plain feature of [-tense] in the other syllable. Achieving tensification in the onset of the target syllable leads to avoid the stops or affricates in the coda; instead, *ø* or sonorants is favored.

(13)		
ku.til.ku.til	k’u.til.k’u.til	<i>dry</i>
ku.pak.ku.pak	k’u.pak.k’u.pak	<i>nodding</i>
čö.kil.čö.kil	č’ö.kil.č’ö.kil	<i>crumpled</i>
pan.čil.pan.čil	p’æn.čil.p’æn.čil	<i>glossily</i>

Tensification in the reduplication requires the feature of [+son] (14) or the final open-syllable (15) before the tense syllable in the previous syllable.

(14)		
sal.čak.sal.čak	sal.č’ak.sal.č’ak	<i>slightly</i>
tiŋ.kis. tiŋ.kis	tiŋ.k’is.tiŋ.k’is	<i>often</i>
p ^h an.tas.p ^h an.tas	p ^h an.t’as.p ^h an.t’as	<i>abruptly</i>
čəl.tuk.čəl.tuk	čəl.t’uk.čəl.t’uk	<i>limping</i>
tam.puk.tam.puk	tam.p’uk.tam.p’uk	<i>fatly</i>

(15)		
ti.kak.ti.kak	ti.k’ak.ti.k’ak.	<i>closely</i>
p ^h ak.čak.p ^h ak.čak	p ^h ak.č’ak.p ^h ak.č’ak	<i>plentiful</i>
t ^h kin.t ^h kin	t ^h kin.t’ ^h kin	<i>pit-a-pat</i>
ki.tak.ki.tak	ki.t’ak.ki.t’ak	<i>nodding</i>

The tensification of onomatopoea in Jeju Korean is slightly different from Seoul Korean in which it occurs after obstruent in the coda of the previous syllable (e.g., *əl.luk.s’o*). In Jeju Korean, it occurs after sonorants such as /l/, /m/, /n/, and /ŋ/ in the coda of the previous syllable (14) as well as after the open-syllable (15). The tensification in (14) can be found in Seoul Korean

¹ Personal communication (2009). I really appreciate his kind comments.

after nasals of the coda in verbs (e.g., *kam.ta* → *kam.t'a*), in Sino Korean (*pal.tal.* → *pal.t'al*), or in modifier (*kam.sa.ta* → *kam.s'a.ta*).

5.2.2 Aspiration

Aspiration occurs in the onset of the first syllable in the emphatic forms.

(16)		
pu.sak.pu.sak	p ^h u.sak.p ^h u.sak	<i>crumbly</i>
pin.čik.pin.čik	p ^h in.čik.p ^h in.čik	<i>glittering</i>
čΛ.kin.čΛ.kin	č ^h Λ.kin.č ^h Λ.kin	<i>orderly</i>
čam.paŋ.čam.paŋ	č ^h am.paŋ.č ^h am.paŋ	<i>paddling</i>

Historically, aspiration appears in Silla dynasty (BC 57 - AD 935), while tensification occurs after Korean-Japanese War in Josun dynasty in 16th century (Ko 1996). Despite these historical facts, aspiration in the emphatic forms should be considered in terms of acoustic phonetics. That is, emphatic forms using aspiration in Jeju Korean prefer the perceptual contrast using the pitch rather than the duration. By following the production experiment, mean F0 of the aspirated obstruents is the highest; female Jeju speakers produce aspirated obstruents of 275 Hz, tensified obstruent of 242 Hz, and plain obstruent of 180 Hz. On the contrary, the vowel duration after the tensified obstruent is the longest as 221 ms, along with aspirated obstruents of 160 ms and plain sounds of 47 ms. Considering that aspirated obstruent is shorter in duration and higher in F0, compared to the tensified obstruent, aspiration in Jeju Korean is closely tied with the perceptual enhancement through the heightened pitch.

The frequency of emphatic forms using aspiration, however, is less than that of the tensified emphatic reduplication. It seems that the historical development of grammatical rules involves in selecting the glottal features, although the productive grammar as well as perceptual principles triggers the asymmetrical distribution between the two laryngeal emphatic forms. Historically, unlike Seoul Korean which permits /h/ in the coda of the base, Jeju Korean prohibits aspirated /h/ in the position (MK *čoh.sip.ni.ta.* → JK *čö.s'i.ta*; MK *t'ah.ta.* → JK *t'ap.ta.*; MK *nəh.ta.* → JK *no.ta*). Accordingly, avoiding aspiration in the reduplicant is closely tied with the /h/ deletion in the position in Jeju Korean. This means that localized grammars distinctively permitted in Jeju Korean involve in the process of emphatic forms using laryngeal feature contrast.

5.2.3 Principles of laryngeal alternation

Both obstruents of tense and aspiration realized as the feature of [stiff] have the tone of [H] in Seoul Korean (Silva 2006, Kenstowicz and Park 2006). Similarly both obstruents have the tone of [H] in Jeju Korean because

the fundamental frequency for both sounds is similar (275 Hz vs. 242 Hz, for female Jeju speakers). Since identity avoidance requires OCP principles, the model of the laryngeal emphatic forms can be set up.

Generally occurrence of the same features tends to be limited in root, word, or reduplication cross-linguistically. MacEachern (1999) reports that laryngeal co-occurrence limitation can be found commonly in Arabic, Javanese, and Japanese in root-level, Chumash in word-level, and Sanskrit in root and reduplication.

(17) Laryngeal co-occurrence restriction (MacEachern 1999)

Sanskrit: Roots and reduplicative constructions do not contain more than one aspirated segment: **tʰutʰ*, **gʱutʱ*

Arabic: Verbal roots do not contain identical consonants are disfavored: **mmd*

Javanese: Homogonic consonants do not occur root-internally, unless they are identical: **bamaʔ* (but, *babot*)

Chumash: Words do not contain sibilants that differ in place of articulation: *osoo* (but, **osof*)

Japanese: Native roots do not include more than one voiced obstruent: **gaze*

MacEachern suggests that laryngeal co-occurrence limitation is quietly related with autosegmentalism and OCP. Also Gallagher (2010) argues that faithfulness constraints on laryngeal features like aspiration, ejection, and implosion must be indexed to two different hierarchical levels, suggesting that **/k'k'/* changes into */k'k'/* based on the data of Peruvian Aymara, Hausa, Cuzco Quechua.

Emphatic reduplication in Jeju Korean tries to avoid containing same laryngeal features in some degree. The OCP effect pursues the perceptual impact. Contrast between tensified or aspirated obstruents in the onset of base and plain obstruents in the onset of reduplicant causes the maximal perceptual distance of pitch and closure duration.

5.3 Vowel alternation

In vowel alternation (1020) checked in this study, the stem structure of total reduplication favors the mid-vowel in penult (59%) and the non-mid vowel in ultima (88%) (e.g., *tʌŋ.kil.tʌŋ.kil*). Especially, */æ/*, or */ə/* may not occur in ultimas, while */ʌ/*, */o/*, or */a/* favors the occurrence in penults. Kang and Rhee (2009) reported that the vowel alternation prefers the change in penult to that in ultima. The search for 395 emphatic forms reveals that the

penult is easily affected as 67% (e.g., *si.lik.si.lik.* → *si.lik.si.lik.*), compared with 17% of ultima (e.g., *i.sil.i.sil.* → *i.sil.i.sil.*). The other 16% of the variations include the syllable insertion, or onset/coda-alternation without changing vowels or consonants themselves (e.g., *kən.tis.kən.tis.* → *kən.til.kən.til.*).

The emphatic form through the vowel alternation employs two patterns: fronting and raising. More than 70% of the vowel changes prefer the raising to the fronting. It is clearly tied with perceptual impact, in which the movement of tongue height produces stronger perceptual prominence than that of tongue fronting (Kent and Read 2003). Also the change occurs frequently in penults rather than in ultimas. It may be related with articulatory movement because the intra-template syllable is easy to change in its vowel qualities rather than the boundary of the template. Along with the vowel height and front, the syllable placement in the emphatic forms (penult or ultima) is very critical since its placement plays the important role in deciding the frequency of the variation.

In the production experiment, independent t-test conducted for each task shows that the variation is greatly related to the height and front of the pre-changed vowels in penults, $t = 28.9$, $p < .0001$, and in ultimas, $t = 4.8$, $p < .05$, the changed vowels in penults, $t = 38.2$, $p < .0001$, and ultimas, $t = 18.7$, $p < .0001$. It means that the syllable placement (penult or ultima) in the structures of base or reduplicant has some influences on the variation forms with height and front in the emphatic reduplication.

5.3.1 Heighten alternation

(18) /o:/u/	$p^h o.kin.p^h o.kin$	$p^h u.kin.p^h u.kin$	<i>mild</i>
	$pol.t^h ak.pol.t^h ak$	$pul.t^h ak.pul.t^h ak$	<i>berserk</i>
	$ko.sil.lak.ko.sil.lak$	$ku.sil.lak.ku.sil.lak$	<i>winding</i>
	$ko.pos.ko.pos$	$ko.pus.ko.pus$	<i>crook</i>
	$po.kak.po.kak$	$pu.kak.pu.kak$	<i>simmering</i>
(19) /a:/i/	$sal.lang.sal.lang$	$sil.lang.sil.lang$	<i>gently</i>
	$p^h a.či.čik.p^h a.či.čik$	$p^h i.či.čik.p^h i.či.čik$	<i>hissing</i>
	$pi.čal.pi.čal$	$pi.čil.pi.čil$	<i>stagger</i>
	$čan.tik.čan.tik$	$čin.tik.čin.tik$	<i>fasten</i>
(20) /a:/ə/	$k^h ul.k^h ak.k^h ul.k^h ak$	$k^h ul.k^h ək.k^h ul.k^h ək$	<i>gulping</i>
	$tu.sang.tu.sang$	$tu.səng.tu.səng$	<i>whisper</i>
	$tim.sang.tim.sang$	$tim.səng.tim.səng$	<i>sparsely</i>
	$kan.til.kan.til$	$kən.til.kən.til$	<i>gently</i>
(21) /a:/u/	$pal.t^h ang.pal.t^h ang$	$pul.t^h ang.pul.t^h ang$	<i>throat</i>
	$kæ.čak.kæ.čak$	$kæ.čuk.kæ.čuk$	<i>noisy</i>

(22) /æ:/i/	pæ.til.lang.pæ.til.lang pæ.s'ik. pæ.s'ik	pi.til.lang.pi.til.lang pi.s'ik.pi.s'ik	<i>flap</i> <i>rustling</i>
(23) /ʌ:/i/	tʌ.k'in.tʌ.k'in tʌl.s'ak.tʌl.s'ak tʌn.čik.tʌn.čik čʌl.kang.čʌl.kang	ti.k'in.ti.k'in til.s'ak.til.s'ak tin.čik.tin.čik čil.kang.čil.kang	<i>steady</i> <i>restlessly</i> <i>heavy</i> <i>chew</i>
(24) /ʌ:/u/	maŋ.kil.maŋ.kil pʌl.k'in.pʌl.k'in kʌm.č'ak.kʌm.č'ak	muŋ.kil.muŋ.kil pul.k'in.pul.k'in kum.č'ak.kum.č'ak	<i>clotty</i> <i>bursting</i> <i>flicker</i>

The vowel raising, mainly /o:/u/ and /a:/ə/, occurs in penult (the first syllable of base), under condition that /a/, /i/, and /o/ remain unchanged in ultima (the second syllable). It means that non-high back vowels tend to rise to the place of the non-low vowels. Height in Jeju Korean vowels is partially predictable. In the stem of the reduplication, it is a common form composed of the non-high vowels in penult and the non-low vowels in ultima. However, this default formation has the emphatic counterpart with high vowels in both penult and ultima as seen in the Table 7.

Table 7. The raising movement of the vowels between original and changed reduplication

	Simple reduplication		Emphatic reduplication	
	Penult	Ultima	Penult	Ultima
High	62	202	212	241
Mid	231	33	91	28
Low	87	152	81	130

This table shows that mid-vowels tend to change to high vowels, while low-vowels tend to keep their articulatory place. In the original reduplications, the forms of mid-vowels in penult and high-vowels in ultima are quite common as 'ko.til.ko.til → ku.til.ku.til.' The majority of stems with the mid-vowels in penults (almost 60%) change as seen in (25a), but approximately 40% fail to rise their vowel height, while the low-vowels in penults refuse to rise their quality to the non-low vowels as seen in (25b).

(25)			
a.	tʌl.s'ak.tʌl.s'ak čʌl.kis.čʌl.kis hək.sak.hək.sak	til.s'ak.til.s'ak čil.kis. čil.kis hik.sak.hik.sak	<i>flutteringly</i> <i>chewing</i> <i>floppy</i>
b.	paŋ.sak.paŋ.sak pan.til.pan.til tal.kaŋ.tal.kaŋ	peŋ.sak.peŋ.sak pan.tik.pan.tik tal.ki.laŋ.tal.ki.kaŋ	<i>smile</i> <i>glittering</i> <i>rattling</i>

For the words in (25b) which refuses to change its heightening, the strategy to choose the variation includes vowel fronting, consonantal onset/coda change, or syllable addition.

5.3.2 Fronting alternation

The vowels of normal reduplication achieve the goal to alternate the vowel feature in penults to the front placement of the vowel inventory.

(26) /i:/i/	sil.kis.sil.kis	sil.kis.sil.kis	<i>frown</i>
	sil.č'ak.sil.č'ak	sil.č'ak.sil.č'ak	<i>furtively</i>
	sil.kang.sil.kang	sil.kang.sil.kang	<i>grinding</i>
(27) /ʌ:/a/	thal.ki.lak.thal.ki.lak	thal.ki.lak.thal.ki.lak	<i>rattle</i>
	pʌ.tik.pʌ.tik	pa.tik.pa.tik	<i>flap</i>
(28) /a:/e/	pa.kil.lak.pa.kil.lak	pe.kil.lak.pe.kil.lak	<i>grumble</i>
	pang.sak.pang.sak	peng.sak.peng.sak	<i>smile</i>
	ča.kil.ča.kil	če.kil.če.kil	<i>shrewd</i>
	hang.kil.lang.hang.kil.lang	heng.kil.lang.heng.kil.lang	<i>swing</i>
(29) /ə:/e/	pən.ti.ling.pən.ti.ling	pen.ti.ling.pen.ti.ling	<i>blankly</i>
	pəl.luk.pəl.luk	pel.lik.pel.lik	<i>flap</i>
	təp.pak.təp.pak	tep.pak.tep.pak	<i>totter</i>
(30) /u:/i/	puk.čak.puk.čak	pik.čak.pik.čak	<i>bustle</i>
	pul.lak.pul.lak	pil.lak.pil.lak	<i>bulging</i>
	ču.čhum.ču.čhum	ču.čhim.ču.čhim	<i>waver</i>

The vowel fronting, mainly in the alternative form of /i/ → /i/, or /a/ or /ə/ → /e/, occurs in penults of base, under the condition that /a/ and /i/ leave unchanged in ultimas. Fronting in Jeju Korean vowels is partially predictable. In the stem of the reduplication, the frequently common forms consist of back-vowels in both penults and ultimas. The formation changes into back-vowels in penults and non-back vowels in ultimas as seen in Table 8.

Table 8. The fronting movement of the vowels from original to emphatic reduplication

	Simple reduplication			Emphatic reduplication		
	Front	Mid	Back	Front	Mid	Back
Penult	45	105	217	73	127	178
Ultima	29	128	162	47	269	68

This table shows that back-vowels tend to move forward to non-back place

(mid or front place) in both penults and ultimas of the emphatic forms. The small percentage of stems with back-vowels in penults as only 25% is fronting, in which the high back vowel of ‘u’ tends to refuse to be fronting as seen in (31a). On the contrary, the majority of back vowels in ultima (almost 57%) are fronting as seen in (31b), in which back-vowels in ultimas are easily frontized rather than those in penults. It means that the vowel front as well as vowel height is critical to trigger the variation, but the degree is different.

(31)

a.	tum.sim.tum.sin su.kun.su.kun ku.pak.ku.pak	tum.sil.tum.sil su.kun.tak.su.kun.tak k’u.pak.k’u.pak	<i>sparingly</i> <i>whisper</i> <i>nodding</i>
b.	pʌ.tak.pʌk čʌŋ.kis.čʌŋ.kis puk.čak.puk.čak mun.čal.mun.čal	pə.tak.pə.tak čɪŋ.kis.čɪŋ.kis pik.čak.pik.čak min.čal.min.čal	<i>flap</i> <i>tight</i> <i>crowded</i> <i>glittering</i>

5.3.3 Principles of vowel emphatic forms

Phonological motivation of perception and production leads the emphatic forms to vowel alternation such as fronting and heightening after morphological repeat. The phonotactic constraints of perceptual OCP (Obligatory Contour Principle) are deeply involved in creating emphatic forms. Boersma (2000) suggests grammar with faithfulness-like constraints that favor the presence of specific acoustic cues in output. By following his assumption, OCP is suggested as the interaction between acoustic cues and perceptual features. In this respect, the constraint of OCP $\Delta(\alpha, \alpha)$ suggests that the maximal acoustic difference between cue 1 and cue 2 causes the perceptual features in output, in which these features form the specific production grammar rules. The difference among some main cues triggers the phonological contrast in emphatic reduplication.

The OCP-like asymmetrical coordination could be found in Seoul Korean (e.g., Park 1993). Kang (2008) suggests that alternative reduplication achieves the semantic emphasis through asymmetrical coordination between base and reduplicant based on the maximum difference of F1 in vowels, or syllable duration in consonants. The asymmetrical distribution of acoustical cues causes the perceptual enhancement in the alternative reduplication (e.g., *mi.kin.* → *mi.kin.mæ.kin*). Both quality and quantity in Jeju Korean, however, are much richer.

Vowel variation in Jeju Korean occurs between input and output, keeping the OCP between penults and ultimas. The vowel raising, mainly derived from the changed form of /o/ → /u/, or /a/ → /ə/, occurs in penults of base, under the condition that /a/, /i/, and /o/ remain unchanged in ultimas of base.

The sound variation occurred in vowels of either penults or ultimas leads to the perceptual contrast between two syllables within base.

It seems that raising and fronting are different phenomena, but the two apparently different movements are merged into the unique perceptual goal: maximizing the difference of F1 and F2 which prefers the difference between the alternative front/high vowels and the unchanged back/low vowels. It is well known that F1 varies mostly with tongue height, while F2 varies mostly with tongue advancement. By following Figure 4, low and back vowels have a small F2-F1 difference, whereas high and front vowels have a large F2-F1 difference. The direction of the vowel alternation clearly pursues large difference between input and output in an emphatic reduplicant. Thus, the direction of fronting and raising pursues the maximum difference between F1 and F2.

5.3.4 The direction of the vowel alternation

The direction of the vowel variation tends to keep the maximal perceptual distance of formants so that the asymmetry between input and output causes the maximum contrast of main formants between penults and ultimas. The reason why the emphatic forms of Jeju Korean favor the non-low front vowels is to meet the maximal distance of perception between penults and ultimas. The direction of the vowel alternation in Jeju Korean is outlined as follows.

First, triggers should be mid-back vowels in both penults and ultimas such as /ʌ/, and /o/, while high-back vowel of /u/ calls for the alternation only in ultimas. It means that syllable placements as well as articulatory places of vowels (height or front) are critical in the variation. Second, the frequency of heightening alternation in low vowels is comparatively rare, while back vowels show the high frequency of alternation to the place of non-back vowels. The difference could be related with the perceptual contrast of formants. The low vowels already have comparatively large distance of the first two formants, while the back vowels show the slight difference between F1 and F2. Third point is that only 25% in penults moves forward to the non-back place, while comparatively large amount of 60% in ultimas causes the alternation. It is questionable why syllable placement has significant influence on vowel alternation.

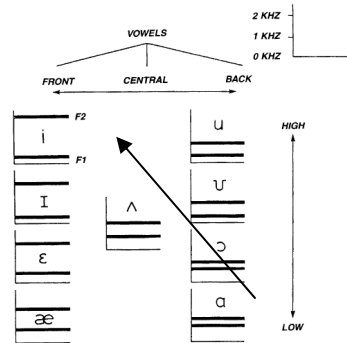


Figure 4. Stylized spectrograms and direction of vowel alternations

The result shows that sound variation triggered by perceptual difference considers the easy articulation. Finally, the maxima forms which reach to the high and front places such as [i] choose other strategies if they want to emphasize the semantic feelings more. The rules of coda addition, syllable addition, onset-alternation in consonants, or tensification or aspiration as feature alternation substitute the effect of vowel alternation.

6. Conclusion

Emphatic reduplication of Jeju Korean pursues the functional relationship between localized grammar of production and universal contrast of perception. Beyond the first morphological reduplication, perceptual OCP strongly is applied under the condition of the identity avoidance between input and output, between the first and second syllable, between base and reduplicant.

The principle of perception produces the localized grammars of production: raising and fronting in vowels, onset deletion and coda addition in consonants, syllable copy, tensification, and aspiration of laryngeal features. The OCP, representing the global constraint of perception, shapes the macro-structure of the emphatic forms, while the asymmetrical feature arrangement to meet OCP causes language-specific grammars specified in Jeju Korean.

In the emphatic process of vowel alternation, feature alternation favors heightening rather than fronting movement. It seems that acoustical impact on F1 contrast is bigger than on F2 contrast in its degree. Thus, the perceptual effect triggers the vowel change in emphatic reduplication. Also consonantal alternation follows the perceptual principles, too. The change in coda or onset through consonantal deletion or addition leads to the perceptual distinction between base and reduplicant. It appears that obstruent cues in

syllable-onset and sonorant cues in syllable-coda raises strong perceptual prominence, leading to the prominent comparison using consonantal acoustic signals. Consonantal alternatives take a strategy to maximize the perceptual prominence between two syllables - changed versus non-changed syllables - through the deletion or addition.

In case of feature alternation, both obstruents of tense and aspirations which realize the feature of [stiff] have the tone of [H] in Jeju Korean similar as Seoul Korean because the fundamental frequency for both obstruents is categorized as high tone group. Since both syllables in the reduplicant require the OCP principles, the laryngeal emphatic syllable can be set up. It means that the universal principle of perception controls language-specific grammars of production.

However, there are some noteworthy limitations of the study. This study cannot provide authentic explanation on three asymmetrical patterns: (1) why the penult syllable favors aspiration rather than tensed obstruents in a template, (2) why vowel raising occurs predominately in penult and fronting favors ultima syllable, (3) why OCP is applied differently; consonantal alternation pursues the OCP effect between the first and second syllable in a template, whereas vowel alternation favors the OCP between base and reduplicant. It appears that morphological constraint has some influence on the deployment of emphatic features. It remains for future works to develop the relationship between the specific syllables (or template) and the phonological grammars.

Appendix A. Experimental word lists

1. Consonantal alternation

Input forms	Output forms
o.sil	ko.sil.ko.sil.
pang.us	pang.kus.pang.kus.
ʌn.čil	kʌn.čil.kʌn.čil
wa.lang	kwa.lang.kwa.lang
i.li.ling	hi.li.ling.hi.li.ling.
ə.uk	hə.uk.hə.uk.
u.lak.	hu.lak.hu.lak.
wa.sak.	pa.sak.pa.sak.
ča.ul.lak	ča.pul.lak.ča.pul.lak
wa.sang.	wa.sang.pa.sang.
hji.k'ɨl.	hji.l.k'ɨl.hji.l.k'ɨl
hji.t'ak.	hji.l.t'ak.hji.l.t'ak.
tʰə.tak.	tʰə.l.tak.tʰə.l.tak.
tʰa.ki.lak.	tʰa.kil.lak.tʰa.kil.lak.
so.lang.	sol.lang.sol.lang.
ča.lak.	čal.lak.čal.lak.

mə.s'ík.	məl.s'ík.məl.s'ík.
čo.kin.	čol.kin.čol.kin.
əl.luk.	əl.luk.əl.luk.
tæŋ.ki.laŋ.	tæŋ.kil.laŋ.tæŋ.kil.laŋ.

2. Feature alternation

sal.čak.	sal.č'ak.sal.č'ak.
tiŋ.kis.	tiŋ.k'is.tiŋ.k'is.
pʰʌn.tʌs.	pʰʌn.t'ʌs.pʰʌn.t'ʌs.
čəl.tuk.	čəl.t'uk.čəl.t'uk.
tʌm.puk.	tʌm.p'uk.tʌm.p'uk.
ti.kak.	ti.k'ak.ti.k'ak.
pʌ.čak.	pʌ.č'ak.pʌ.č'ak.
tʌ.kin	tʌ.k'in.tʌ.k'in.
ki.tak.	ki.t'ak.ki.t'ak.
pu.sak.	pʰu.sak.pʰu.sak.
pin.čik.	pʰin.čik.pʰin.čik
čʌ.kin	čʰʌ.kin.čʰʌ.kin.
čam.paŋ	čʰam.paŋ.čʰam.paŋ.

3. Vowel alternation

pʰo.kin.	pʰu.kin.pʰu.kin.
pol.t'ak.	pul.t'ak.pul.t'ak.
ko.sil.	ku.sil.lak.ku.sil.lak.
ko.pos.	ko.pus.ko.pus.
po.kak	pu.kak.pu.kak.
sal.lang.	sil.lang.sil.lang.
pʰa.či.čik.	pʰi.či.čik.pʰi.či.čik.
pi.čal.	pi.čil.pi.čil.
čan.tik	čin.tik.čin.tik.
k'ul.k'ak	k'ul.k'ək.k'ul.k'ək.
tu.sang	tu.səŋ.tu.səŋ.
tīm.sang.	tīm.səŋ.tīm.səŋ.
kan.til.	kən.til.kən.til.
pal.tʰang.	pul.tʰang.pul.tʰang.
kæ.čak.	kæ.čuk.kæ.čuk.
sil.kang.	sil.kang.sil.kang.
pʌ.tik	pa.tik.pa.tik.
pa.kil.lak.	pe.kil.lak.pe.kil.lak.
pang.sak.	peng.sak.peng.sak.
ča.kil.	če.kil.če.kil.
pən.ti.ling.	pen.ti.ling.pen.ti.ling.
pəl.luk.	pel.lik.pel.lik.
təp.pak.	tep.pak.tep.pak.

puk.čak.	pik.čak.pik.čak.
pul.lak	pil.lak.pil.lak.

REFERENCES

- BOERSMA, PAUL. 2000. *The OCP in the perception grammar*. Ms. University of Amsterdam. (www.fon.hum.uva.nl/paul/papers/ocp_perc.pdf)
- CHAE, WAN. 1987. Kukersanjinglonuimeochmunje (Some problems on Korean sound symbolisms). *Korean Linguistics* 16, 277-300.
- _____. 2003. *Hankookeruiiseongeruitaeer* (Korean idiophones). Seoul: Seoul National University Press.
- CHEONG, SEOUNG-CHEOL. 1996. The dictionary of Jeju Korean. *Korean Literature and Linguistics* 116, 466-470.
- CHO, TAE-HONG, SUN-AH JUN, SEUNG-CHEOL JUNG and PETER LADEFOGED. 2000. The vowels of Jeju. *UCLA working papers in phonetics* 98, 81-94.
- CHO, TAE-HONG, SUN AH JUN and PETER LADEFOGED. 2002. Acoustics and aerodynamic correlates of Korean stops and fricatives. *Journal of Phonetics* 30, 193-228
- DHILLION, RAJDIP. 2007. Turkish empathic reduplication: Balancing productive and lexicagized forms. www-classic.uni-graz.at
- FLEMMING, EDWARD. 1996. Evidence for constraints on contrast: The dispersion theory of contrast. *UCLA working papers in phonology* 1, 86-106.
- _____. 2005. Speech perception and phonological contrast. In D. Pisoni and R. Remez (eds.). *The Handbook of Speech Perception*. Cambridge: Blackwell.
- GALLAGHER, GILLIAN. 2010. *The Perceptual Basis of Long-distance Laryngeal Restrictions*. PhD Dissertation. MIT.
- GOLDSMITH, JOHN. 1976. *Autosegmental Phonology*. PhD Dissertation. MIT.
- INKELAS, SHARON. 2008. The dual theory of reduplication. *Linguistics* 46.2, 351-401.
- JUN, JONGHO and HYEMIN LEE. 2006. Variable affix position in Korean partial reduplication. *Studies in Phonetics, Phonology and Morphology* 12.1, 149-151
- KANG, KONG-TAEK. 1986. *Jejubangeonuibanbokbusagujoyeonku*. (*The Study on the Structure of Adjective Repetition in Jeju Dialect of Korean*). MA Thesis. Cheju National University.
- KANG, SEOKHAN. 2008. The production and perception in alternative and symmetrical Korean reduplication. *Eomunyeonku* 60, 5-25.
- KANG, SEOKHAN and SEOK-JAE RHEE. 2009. Vowel emphatic reduplication in Jeju Korean. *Studies in Phonetics, Phonology and Morphology* 15.3, 423-439
- KENSTOWICZ, MICHAEL and CHIYOUN PARK. 2006. Laryngeal features and tone in Kyungsang Korean: a Phonetic study. *Studies in Phonetics,*

- Phonology and Morphology* 18, 318-345.
- KENT, RAY and CHARLES READ. 2003. *Acoustic analysis of English*. Boston: Singular Thomson.
- KO, TONG-HO. 1996. The formation process of aspiration and tensification in Jeju dialect of Korea. *Hangeul* 234, 163-189.
- LADEFOGED, PETER. 2001. *Vowels and consonants: An introduction to the sounds of languages*. Oxford: Blackwell Publishers.
- LEBEN, WILLIAM. 1973. *Suprasegmental Phonology*. PhD Dissertation. MIT.
- LEE, YONG-HEE. 1982. *Jejubangeomuiiseongeruitaeryeonku (The Study on the Idiophones of Jeju Dialect)*. MA Thesis. Cheju National University.
- MACEachern, MARGARET. 1999. *Laryngeal Co-occurrence Restrictions*. New York: Garland.
- MCCARTHY, JOHN. 1986. OCP effects: Gemination and antigemination. *Linguistic Inquiry* 17, 207-63.
- _____. 1995. *Extensions of faithfulness*. Ms. University of Massachusetts at Amherst. (works.bepress.com/john_j_mccarthy/59/)
- PARK, CHANG-WON. 1993. Hyundaekookerui seonguitaeruihyungtae (The shapes of modern Korean idiophones). *New Korean Life* 3.2, 5-25.
- SILVA, DAVID. 2006. Acoustic evidence for the emergence of tonal contrast in contemporary Korean. *Phonology* 23, 287-308.
- SONG, SANG-JO. 2007. *CecumalKinSacen. (The Great Dictionary of Jeju Lexicon)*. Seoul: Hankookmunhwasa Press.
- STERIADE, DONCA. 1995. *Neutralization and the expression of contrast*. Ms. UCLA.
- _____. 1997. Phonetics in phonology: the case of laryngeal neutralization. *UCLA working papers in linguistics* 3, 25-146.
- SUZUKI, KEIICHIRO, 1998. *A typology investigation of dissimilation*. Doctoral dissertation. University of Arizona.
- URBANCZYK, SUZANNE. 2005. Enhancing contrast in reduplication. In Bossong, Comrie, and Matras (eds.). *Studies in Reduplication*, 211-235. Berlin: Mouton de Gruyter.
- WEDEL, ANDREW. 2000. Perceptual distinctiveness in Turkish emphatic reduplication. *WCCFL* 19, 546-559.
- WRIGHT, RICHARD. 2001. Perceptual cues in contrast maintenance. In Hume and Johnson (eds.). *The role of speech perception phenomena in phonology*, 251-277. New York: Academic press.
- YIP, MORIA. 1998. Reduplication as alliteration and rhyme. *Glott International* 4.8, 1-7.

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