A variation view on vowel insertion in loanwords*

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Lee, Ponghyung. 2010. A variation view on vowel insertion in loanwords. *Studies in Phonetics, Phonology and Morphology* 16.3. 415-431. We claim that a variation view is integral to explore an array of the vowel insertion arising amidst of the English loanword adaptation into Korean. For the purpose, it needs to stretch the reach of phonological variation: inter-contextual variation, which results from the allowance of candidates without sharing the input, and intra-contextual variation, which means the free variation in a traditional sense. This type of reorganization enables us to account for the phonological variation in a consistent way, i.e., the higher a variant ranks, the more frequent and well-formed it is, as was attempted by Coetzee (2004 *et sequel*). For the lexical exceptions, our contention is that a morpheme-specific indexation in collaboration with constraint indexation intervenes for over- and underapplication of concerned processes. **(Daejeon University)**

Keywords: variation, frequency, rank ordered candidate, lexical indexation, loanword, overapplication, underapplication

1. Categorical vs. variable operations

With respect to variability of linguistic operations, the dichotomy of the categorical vs. the variable is available. When it comes to the vowel insertion occurring in the midst of English loanword adaption into Korean (Broselow and Park 1995, Lee 1998, Rhee and Choi 2001, Kang 2003, to name just a few), the observation is well supported, as diagramed by the contrast of vowel insertion at the post-sonorant vs. post-obstruent context below:

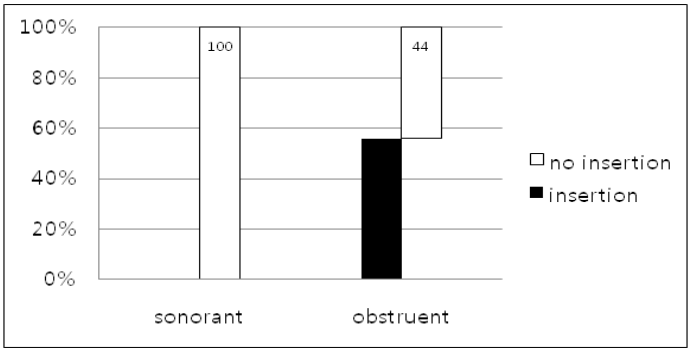

Figure 1. Vowel insertion rate of sonorants vs. obstruents

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The diagram above can be cited as a canonical case of the polarity between categorical vs. variant operations: After sonorants, vowel insertion is absolutely banned while after obstruent stops, a typical kind of variation arises. Among 447 tokens obtained from the written corpus built by the National Academy of Korean Language (NAKL) comprising word-final obstruent stops from English into Korean, .56 rate of vowel insertion is permitted while no vowel insertion is found with word-final sonorants, never among 472 tokens (/l/ 239, /n/ 233).

Here our immediate goal is to explore the phonological variation involved with obstruent stops. We contend that two distinct types of variation are subject to a homogeneous analysis: inter-contextual variation arising from the disparities, owing to the syntagmatic contextual motivation like *pick*[ø]~*peak*>[ɨ], *pat*[ø]~*pad*[ɨ], *tip, kick*[ø]~*pot*[ɨ]; intra-contextual variation, in other words, paradigmatic variation such as *robot*[ø]~[ɨ], *hip*[ø]~[ɨ]. The formal explanation based on the framework of ranked ordered candidate set will be employed to seek the idea that most variation is decided by grammar rather than by sociolinguistic factors.

The rest of this article is structured as follows: The overall variation at the post-stop position in Korean loanwords from English will be surveyed in §2. When it comes to the data set involving inter-contextual variation, we will be relying on the previous literature. On the other hand, for the intra-contextual variation, we will be conducting perception tests of Gradient Well-Formedness Judgment Test and Comparative Well-Formedness Judgment Test. §3 explores the variation occurring at loanword adaptation under the standpoint of frequency/well-formedness as candidate-rank model offered by Coetzee (2004 *et sequel*). §4 concerns the aberrant morphemes challenging our analysis in terms of lexical and constraint indexations. §5 shows that we are apt to get into trouble when we adopt other models like cophonology, floating constraint grammar, and so forth. The final section will draw conclusions from the present study.

2. A survey on variation[1]

2.1. Inter-contextual variation

Let us start with our survey from the inter-contextual variation. As we can see in <Figure 1>, the mean rate of vowel insertion, based on total 447 tokens listed in the NAKL corpus, amounts to 56%. The statistics are obtained from the overall average of three sub-types: tenseness, voicing, place of articulation effects, which were delineated by Kang (2003).

[1] For the statistical examination, alongside of the NAKL corpus, two additional resources are available for now: Rhee and Choi (2001) and Kang (2003). Two investigations concerned different sources: the former investigated unidentified dictionaries, newspaper, magazines, and so forth, whereas the latter explored the foreign word corpus collected by the National Academy of the Korean Language (1991). The statistics resulted from my own exploration of the NAKL corpus show a slight discrepancy from the investigation by Kang(2003).

Let us examine the tenseness effect first. Obstruent stops borrowed from English after tense vowels turn out to far more surpass the lax vowels in terms of vowel insertion. Following the observation, our task is to pursue the proactive nature of tense vowels to facilitate vowel insertion after the following stops. Perusing the NAKL corpus, 33% (99 among 303) of lax vowel triggers vowel insertion while 89% (153 among 171) of tense vowels do:

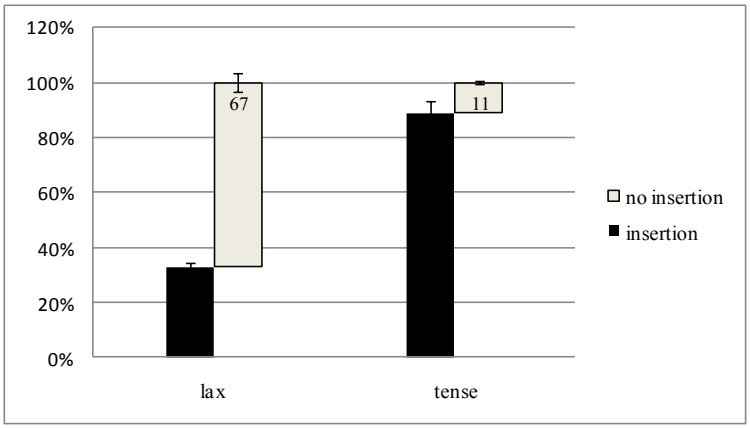

Figure 2. Vowel insertion after lax vowels vs. tense vowels

Next, when it comes to the voicing effect, the facilitation of vowel insertion by voiced stops, among the NAKL corpus, 43% (160 among 370) of voiceless stops trigger vowel insertion whereas 88% (92 among 104) of voiced stops allow it, respectively, as shown by <Figure 3>:

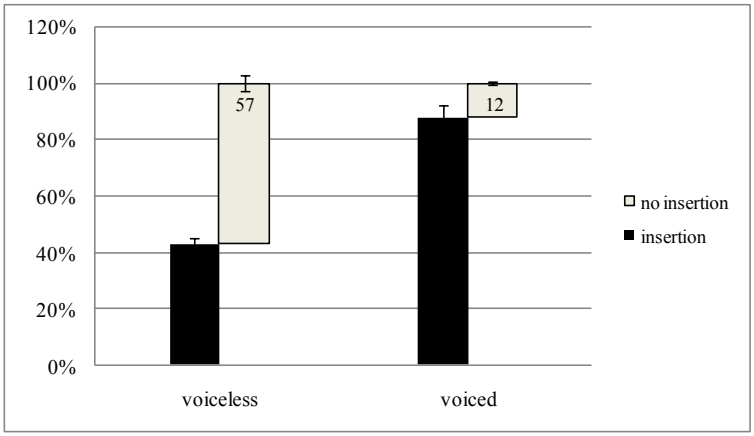

Figure 3. Vowel insertion after voiceless vs. voiced stops

Next, as part of the place of articulation effect, among three places of articulation, coronal stops favor vowel insertion far more than either labial or velar equivalents. Among the two stops with peripheral place of articulation, velar consonants slightly surpass the case of labial consonants. According to the estimation from the NAKL corpus, labial stops trigger 24% (20 among 84), coronal stops 74% (181 among 245), velar stops 35% (51 among 145), respectively. The coronal dominance is not so much surprising to us. As we can verify in /t,d/-deletion (Guy 1991, Coetzee 2004, /t,d/-flapping (Hong 2008), /t/-glottalization (Kahn 1976) in English, it is not unusual to find coronal-skewed operations across languages.

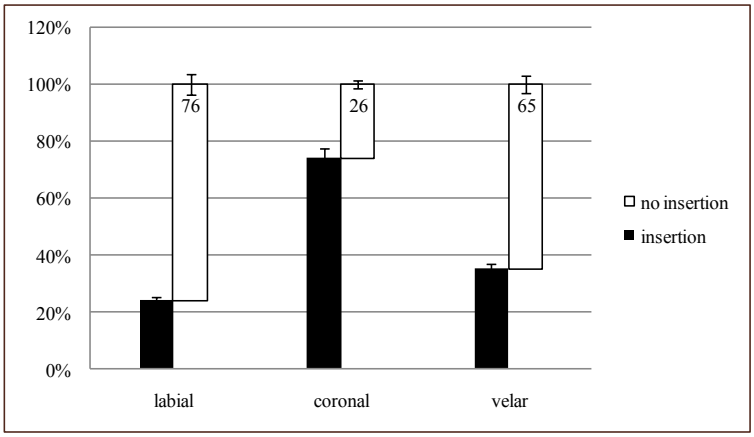

Figure 4. Vowel insertion associated with each place of articulation

2.2 Intra-contextual variation

2.2.1 Gradient well-formedness judgment test (G-test)

A handful of free variation involved with loanwords is found in the NAKL corpus.[2] To improve the credibility of the coronal-skewed distribution of free variation (22 among 27, shown by Appendix), we conducted a couple of perception test.[3] 12 monosyllabic words ending with coronal stops and the same number with non-coronal words

[2] The NAKL corpus barely gives us data displaying variants associated with voicing and tenseness effects. For this reason, we are going to focus on the intra-contextual variation under the viewpoint of the place of articulation.

[3] Aside from the size of the NAKL corpus, we might not be quite sure whether it really discloses the current linguistic realities on loanword adaptation. It was completed almost two decades ago, and the current situation might have changed from that of the past. For example, Silva (2006) observes that there is a noticeable gap between older and younger generations regarding VOT values involved with Korean stops. Another thing is that to reduce the orthographic impact of the stimuli to the response, the participants were repeatedly reminded of the purpose of the experiment that it is a test for examining how Korean speakers use the loanwords in a colloquial style rather than how they convert the input into Korean scripts.

served as stimuli. Per each English input, two options (insertion vs. non-insertion version) are available. Thus 1,448 (24x2x31) tokens were collected in total. Participants were asked to mark the degree of well-formedness of the given stimulus as a Korean word. The stimuli were tested under the 5-point scale. The list of 48 stimuli was randomized. Subjects comprise 7 male and 24 female native Korean speakers, ranging from 19 to 24 years old, who have neither optical disorders nor dyslexia by their self-assessment. They were exposed to a practice session just before the real test started off. They were asked to figure out a comfortably intimate situation where they chat with their close friends, imagining a carrier sentence "Nan̈in _____i(ka) tʃoa 'I love ____.' The test took approximately 25 minutes. The ranges of average well-formedness points associated with stimuli involving vowel insertion are boxploted as <Figure 5>:

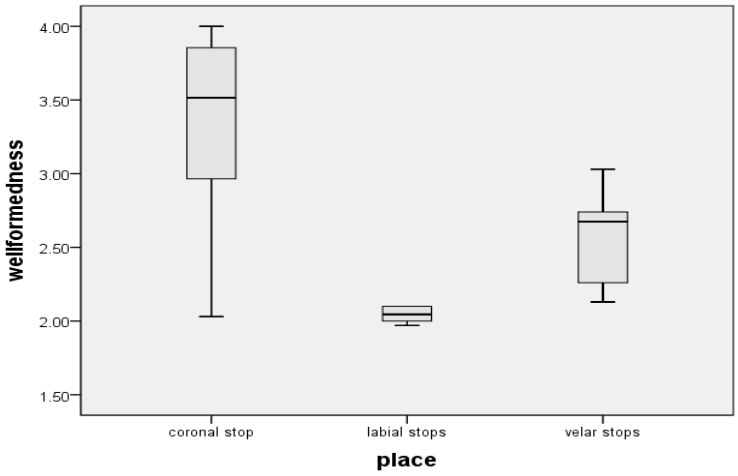

Figure 5. Gradient well-formedness judgment rate

To determine the impact of places of articulation to the well-formedness judgment involving vowel insertions, the One-way analysis of variance (ANOVA) was calculated. As expected, the main effect of place of articulation revealed a reliable difference between groups [$F(2, 21)=12.069$, $p<.000$]. Second, to examine the effect of places of articulation for well-formedness for those with vowel insertion, pair-wise comparisons between three groups were analyzed as part of Post hoc multiple comparison test (Bonferroni). It turns out that the mean differences are significant at the .05 level: coronal-labial $p<.000$, coronal-velar $p<.037$. In contrast, it shows no significant difference in labial-velar pair $p<.280$. Neither of the experimental findings seriously contradicts the data obtained from the NAKL corpus shown above. It means that no significant change with regard to vowel insertion has taken place during the last two decades.

2.2.2 Comparative well-formedness judgment test (C-test)

To further increase the credibility of our data, another kind of perceptual test, Comparative Well-Formedness Judgment Test (henceforth C-test) was administrated and the same participants as in the Gradient Well-Formedness Judgment Test (henceforth G-test) were employed. As in the former experiment, they underwent a practice session before the real test got started off. The test took 15 minutes or so. Three options for preference, inserted, non-inserted, no decision were provided and all the test items were randomized. Overall, 744 (24x31) tokens were come by. The test results opting for no-decision are boxploted as <Figure 6>:

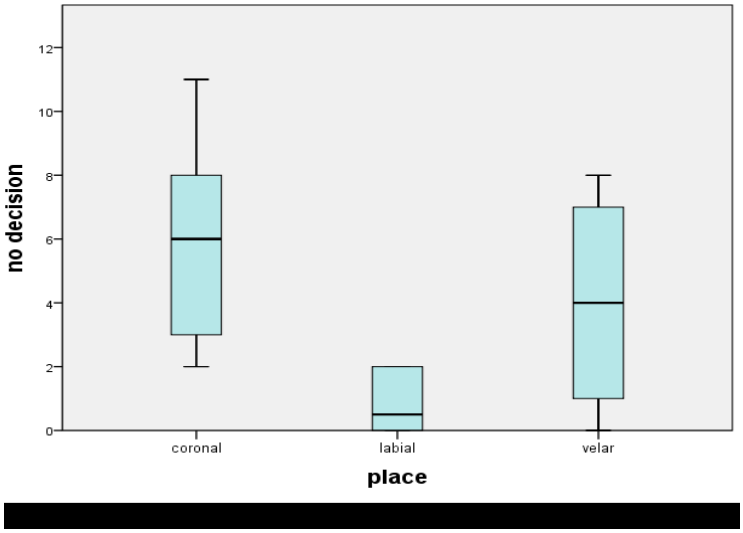

Figure 6. Variation rates

One-way ANOVA compares the mean scores of vacillation between inserted and non-inserted forms. (Here variation is named as "no decision") Across three places of articulation, it yielded a significant effect of contrast [$F(2, 21)=7.276$, $p<.004$], However, Post hoc pair-wise comparisons (Bonferroni) revealed that the variation shows only partial significance. While the difference is significant in coronal-labial [$p<.003$], the significance is denied in other pairs. The discrepancy between G-test and C-test is somewhat perplexing to us. Our former perception test (G-test) as well as the NAKL corpus revealed that coronal stops far surpass labial and velar stops in their favor for triggering vowel insertion. However, the result from C-test neither contradicts the findings of G-test nor supports them. Although the pecking order among three place of articulation is maintained, it is true that the pair-wise differences between labial-velar and coronal-velar are not statistically supported.

Here, instead of hastily abandoning our hypothesis on the

coronal-favored variation, our priority is put to trace the origin of the odds between the data offered by G-test and C-test. First of all, notice that the relative reduction of stimulus size in C-test by half, compared to G-test might affect the results. The cutting back of stimuli is likely to give rise to something like ceiling or bottom effects. Nonetheless, considering the maintenance of pecking order among them, it would be safe to say that the C-test partially supports our contention that coronal stops are the most generous to vowel insertion among three groups of stops. All in all, the general perspective that the intra-contextual variation scatters around coronal consonants would be still valid.

3. An analysis under the candidate rank ordering model

3.1 Frequency/well-formedness and candidate ordering

We have observed that two kinds of variation are operative in vowel insertion: For one thing, variation arises due to the inequalities in triggering potential of the involved contexts. For another, the other type of vowel insertion is blind to the involved context. It refers to the conventional sense of variation, e.g. *e*[ɪ]*ntire* ~ *e*[e]*ntire, kep*[ø] ~ *kept* in English, [məgi] ~ [megi] 'food,' [ilt'a] ~ [ikt'a] 'to read' in Korean. Under the classical OT, unranked constraints or cophonology have been proposed to justify the appearance of the doublets (Kiparsky 1993, Anttila 1997). However, the variation arising from different contexts poses a serious challenge to the framework. The disparity among the variants is rarely amenable to the traditional candidate evaluation machinery. The dichotomy between a single winner and rest of losers scarcely afford to handle the inequity among the seemingly losers, for example .76 of labial stops and .65 of velar stops. The cophonology will be just valid when the probability of each variant is comparable. Facing those problems, we are going to adopt the basic idea of rank ordered candidates proposed by Coetzee (2004). The upshot is that candidates are rank ordered and the ordering means the relative frequency/well-formedness as a variant.

3.2 The critical cut-off and candidate disfavor

Still we are wondering why a certain operation tends to facilitate variants while others do not. Under Coetzee's (2004) model, constraints are regarded as belonging to one of two sides demarcated by a critical cut-off. This model presumes that variants are prompted when more than one candidate observe the constraints placed above the critical cut-off while they just violate below the critical threshold.[4] Technically speaking, the candidate disfavored by constraints above the cut-off is ruled out from further consideration.[5]

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[4] It would be mandatory to enrich the scenario for variation. That is, the option of the tied disobedience of constraints above the critical cut off should be added to the inventory for variation. Coetzee's position that only candidates disobeying the constraint below the critical cut-off are eligible for variants seems to be a too strong stance.

[5] Let us quote the definition of "candidate disfavor" available in the current OT

Under the setting on variation as violation-below-cut-off, let us explore categorical process first. As pointed out in §1, vowel insertion is categorically denied at the post-sonorant consonants. As we can see later, most loanwords oppose segmental deletion, and instead, opt for vowel insertion. This means the faithfulness hierarchy: Max >> Dep. Another thing is that the commonplace occurrence of variation in vowel insertion leads us to believe that Dep is located below the cut-off while Max is at the opposite side. For the explanation of the prohibition of vowel insertion behind sonorants, the following markedness constraint will be developed:

(1) Align-Sonorant Right(σ,ω)
The right edge of a syllable ending with sonorants aligns with that of a phonological word. The candidates are ranked according to the performances at the table, as noted by leftmost labels. The violation of Align-Sonorant-R(σ,ω) and Max ranked above critical line is fatal enough for the second and third candidates to be disqualified as variants in tableau (2):

(2) Categorical blocking: post-/l/

'seal'	Max	Align-Sonorant-R(σ,ω)	Dep
1 seal			
2 seal~~ɨ~~		*!	*
3 sea ø	*!		

The same thing happens to the input like *sign, tour*. Variation is disallowed here since except for the best candidate (labeled 1), the second and third best candidates violate constraints above the cut-off. For the vocalization of word-final /r/, constraint *Coda /r/ will be added:

(3) *Coda-/r/
Coda ending with /r/ is banned.

(4) Categorical blocking: post-/r/

'tour'	Max	*Coda-/r/	Align-Sonorant	Dep
1 touə				
2 tour		*!		
3 tour~~ɨ~~			*!	*
4 touø	*!			

Aside from /touə/, the rest of the candidates are banned as variants, owing to the liability of violating the constraints placed above the cut-off

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literature:
Candidate Disfavor (Samek-Lodovici and Prince 1999)
Candidate $cand_1$ is disfavored by constraint C if there is some other candidate $cand_2$ that earns fewer violations in terms of C and $cand_1$.

3.3 Inter-contextual variation

As pointed out above, the revised view on the EVAL component of OT architecture enables us to put forth inter-contextual variation properly. By presuming that the rank ordering is possible among candidates without input sharing, a direct comparison of candidates hailing from different inputs works positively when it comes to the disparity of vowel insertion arising in the different contexts. First, let us consider the tenseness effect. For the explanation of lax and tense vowels in the light of facilitating vowel insertion, markedness constraint Trigger-Release is developed:

(5) Trigger-Release
The triggering [release] of a segment to a neighboring segment is preserved.

According to Kang (2003), it is universally true that tense vowels surpass lax vowel in their nature of prompting release phase of the following stops:

(6) The tenseness effect

'beat, bit'	Max	Trigger-Release	Dep
1 beatɨ			*
2 bitɨ		*	*

Next, we believe that constraint (7), preferring passive voicing in the intervocalic context is in charge of the asymmetry between voiced vs. voiceless obstruent outputs:

(7) *V[voicelss]V
Intervocalic voiceless sounds are banned.

'tab, tap'	Max	*V[vcls]V	Trigger-Release	Dep
1 tabɨ				*
2 tapɨ		*!		*

Lastly, let us consider the vowel insertion probability: coronal stops > velar stops >labial stops. As pointed out in §2, triggering phonological operations aiming at coronal stops is quite common across languages. Thus it must be understood that operations specific to coronal stops is not parochial just to vowel insertion here. For the purpose, we formulate the markedness constraint *Coronal Coda. The dislike of coronal coda is frequently found with nasal consonants, as observed by Trigo (1989).

(8) *Coronal Coda
Coronal codas are disliked.

Next, for the dislike of vowel insertion of labial and velar stops, constraint (9) is developed:

(9) Align-*P/K*-Right (σ, ω)
The right edge of labial and velar stops of a syllable aligns with that of a phonological word.

'tip, kit, kick'	Max	Align-*P/K*	*V[vcls]V	Trigger -release	*Coronal Coda	Dep
1 kitɨ			*			*
2 kickɨ		*!	*			*
3 tipɨ		*!	*			*

It is out of question that the violation of Align-*P/K*-Right (σ,ω) by *kickɨ* and *tipɨ* results in demoting them below *kitɨ*. The reason why Align-*P/K*-Right (σ,ω) ranks above the critical cut-off will be discussed in the next section.

3.4. Intra-contextual variation: coronal-biased

The most remarkable thing about intra-contextual variation regarding vowel insertion is that the vast majority of the triggering consonants in favor of vowel insertion belong to coronals, even though it was partially supported by our well-formedness tests. Now it is time to put forth the coronal dominant vowel insertion from the viewpoint of frequency/well-formedness as candidate-rank. In accordance with the rationale, as we discussed in §3.3, we claim that positing *Coronal-Coda below the cut-off is crucial to invoke the variation.

(10)

'cut'	Max	Align-*P/K*	*V[vcls]V	Trigger-Release	*Coronal-Coda	Dep
1 cut					*	
2 cut^{h}ɨ			*		*	
3 cuø	*!					

Candidates *cut* and *cut*^{h}[ɨ] obey all the constraints ranked above the cut-off and they are just disfavored by the constraints below the critical demarcation and thus the first and second best constraints are predicted to be legitimate variants. On the other hand, for labials and velars, markedness constraint *Coronal-Coda exerts no consequences and for that reason, variation is not enforced, as demonstrated below.

(11)

'cup'	Max	Align-P /K	*V[vcls]V	Trigger-Release	*Coronal - Coda	Dep
1 cup						
2 cup^{h}i̯		*!				*
3 cuø	*!					

Above the cut-off, except for the single candidate *cup*, the rest of them crucially violate the constraints and thus they are disqualified as a variant. The same explanation is applicable to the blocking of variation involved with velar stops.

4. Lexical and constraint indexation

4.1 Overapplication

There is a portion of exceptional examples challenging the setting given above. First, let us explore what happens with overapplication of vowel insertion. Here we consider exceptions to the place of articulation effect. Considering that vowel insertion after labial and velar stops is not predicted, the actual outputs like *hip* [hip^{h}i̯] and *shock* [ʃok^{h}i̯] appear to refute our analysis. Facing the exceptional overapplication of phonological processes, we are going to rely on lexical indexation which applies to the concerned lexical items and corresponding constraints simultaneously. Here we employ constraint Foot-Binarity (Prince and Smolensky 1993/2004) to account for the vowel insertion.

(12) Foot-Binarity
To be a foot, at least two syllables are necessary.

Constraint (12) serves to augment the number of syllable involved in monosyllabic words.[6] Note the table (13):

(13)

'hip$_{L1}$'	Max	FT-Binarity$_{L1}$	Align-*P/K* (σ, ω)	*Coronal-Coda	Dep
1 hip^{h}i̯			*		*
2 hip		*!			
3 hi	*!	*			

The indexed lexical item *hip*$_{L1}$ enjoys a privilege, subject to the reach of markedness constraint Foot-Binarity, unlike its homophone

[6] There is just one exception to the effectiveness of Foot-Binarity in the NAKL corpus: *mosaic*.

neighbor *hip*. Because candidate [hip] in tableau (13) violates Foot-Binarity which ranks above the critical cut-off, the tableau predicts the inserted form [hip^{h}ɨ] is an exclusive output. However, that is not the whole story. We are well aware of the fact that [hip] and [hip^{h}ɨ] show variation in Korean. To resolve the puzzling enigma, we will regard the indexed lexical item as being independent of its apparent variant [hip]. Lexical indexation makes it possible for them to be discrete in terms of morphological affiliation. The same thing happens to the variation taking place in a word like *shock*.

Our contention that the number of syllables makes a difference in determining vowel insertion is advocated by the previous statistical results. According to Rhee and Choi (2001), the tipping point to decide the vowel insertion falls between mono- and dual-syllable inputs. As we can see in <Figure 7>, monosyllabic words prefer vowel insertion while multi-syllabic words are antagonistic against the paragoge.

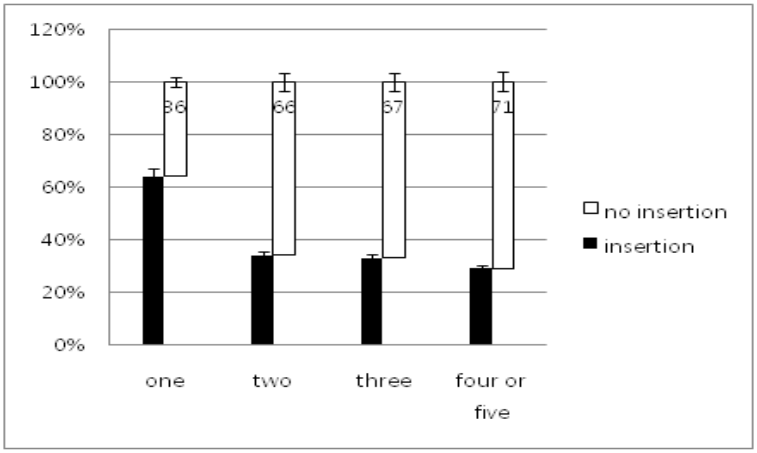

Figure 7. Vowel insertion and word length

Foot-Binarity seems to encourage the vowel insertion with monosyllabic words, resulting in extension of word length. The supporting evidence of intervention of Foot-Binarity is found in the minuscule or negligible difference among words comprising two, three, and four plus syllables regarding vowel insertion, .34 vs. .33 vs. 29, respectively, as shown by <Figure 7>. As a consequence, it is obvious that Foot-Binarity is just recruited to distinguish between mono- and multi-syllabic words.

4.2. Underapplication

Vowel insertion sometimes underapplies to lexical items: for example, *Ipod* surfaces as [aip^{h}at] rather than [aip^{h}adɨ]. Facing the underapplication of a phonological operation, indexed faithfulness, DEP_{L2} is placed above the critical cut-off, and thus the second

candidate undergoing vowel insertion in tableau (14) is banned.

(14)

/ipod$_{L2}$/	Dep$_{L2}$	Max	Align/ *PK*	*V[vcls]V	*Coronal - Coda	Dep
1 ipot					*	
2 ipodɨ	*!					
3 ipoø		*!				

4.3. Constraint stratification

In the course of discussion we have found that for the explication of vowel insertion across contexts as well as within contexts, a constraint hierarchy is invoked just between Align-*P/K*-Right (σ,ω) and FT-Binarity$_{L1.}$ As a consequence, for the most part, we need the stratification between those sitting above the critical cut-off and the others huddling together below it, as arranged as follows:

(15) Constraint stratification[7]

Dep$_{L2,}$ Max, *Coda-r, Align-Sonorant R(σ,ω)
FT-Binarity$_{L1}$
|
Align-*P/K*-Right (σ, ω)
---------- cut off
Trigger-Release, *V[vcls]V, *Coronal-Coda, Dep

5. Problems with previous approaches

5.1 Pre-OT

SPE developed optional application as part of the account of phonological variation, and variable rules offered in sociolinguistic (Labov 1969) are basically indistinct from the SPE tradition. The view of variation as optionality represents the presumption that variation is rare or few among phonological operations. However, as pointed out by Boersma (1998), most phonological operations are subject to variation. Also the attribution of variation to post-lexical processes in Lexical Phonology (Kiparsky 1982, 1985) are widely challenged by findings of earlier application of optional rules, such as English secondary stress rules, which are proved to definitely lexical processes.[8]

5.2. Within OT

As mentioned in §3, the biggest problem with cophonology or

[7] For the lack of further evidence and following the constraint demotion model of Tesar and Smolensky (1996), all the concerned constraints outrank Align-*P/K*-Right (σ, ω).

[8] For instance, the underlined syllables show variation: *advantageous, authenticity, condemnation, ambassador, Atlanta, Kentucky, September, sincere, obscene, accelerate.* (Coetzee and Pater 2009)

unranked model for phonological variation by Kiparsky 1993, Anttila 1997, Anttila and Cho 1998, among others, arises in the rate of frequency of variants. Under our model, it is presumed that variation should be understood as products of the rank ordering among candidates and lexical indexation. The discrepancy in frequency among candidates is determined by the candidate ranking so that the higher one is more frequent and well-formed while lower one is the other way around. On the other hand, the cophonology predicts the evenly comparable distribution of the variants, and the floating model for variation faces the same kind of problem (Reynolds 1994). On the other hand, the stochastic model for phonological variation is subject to criticism from a different dimension. Instead, it tries to reflect directly the frequency rates of each variant into grammar. As widely reported by the previous literature (Silverman 1992, Iverson and Lee 2006, Pepperkamp et al 2008, Lee 2009), loanword adaptation is subject to the grammar-external factors like spelling, perception, affective factors as well. The stochastic model overlooks the role of those extragrammatical influences, on top of grammar, in shaping the adopted results.

6. Concluding remarks

We have explored the phonological variation available in loanword phonology from the viewpoint of frequency/well-formedness as candidate-rank. One of our findings is that the present setting enables us to compare candidates stemming from hetero-morphemic input in addition to those from homo-morphemic inputs. It shows that there is an indispensable connection between the relative frequency and candidate ranking. This kind of strides towards enriching EVAL makes it possible to identify the relative frequency/ well-formedness of each candidate, which is grounded on perceptual tests as well. For another, our worry that the addition of ranks among candidates might overburdens OT apparatus can be counterbalanced by the reduction of crucial hierarchy among constraints. It seems that the stratification of constraints is likely to replace the constraint hierarchy.

Basically, classical OT has kept silent about the one-on-one comparison of the variation situated at different contexts like post-tense vs. lax vowels, post-voiced vs. post-voiceless obstruents, etc. Any comparative tool was to no avail to make certain which context is more lenient or hostile to a certain process. As a strategy for treating exceptions, we claimed that it is necessary to presume that both faithfulness and markedness constraints are subject to lexical indexation. The former strategy accounts for underapplication while the latter is responsible for the overapplication, respectively. Our findings are significant to get rid of some dubious points concerning an array of linguistic variation and loanwords phonology in general, and make sure that substantial part of variants for a stimulus is determined in the midst of grammatical operations rather than by grammar-external factors.

Appendix: Intra-contextual variation listed in the NAKL corpus

variation	examples	no variation
tense-/p/ (3)	jeep, tape, soup	lax-/p/
tense-/k/ (1)	cake	lax-/k/
tense-/t/(3)	scout, flute, shoot	lax-/b/
lax-/g/(1)	zigzag	tense-/b/
lax-/d/(1)	pyramid	tense-/g/
lax-t(18)	rocket, bonnet, credit, cut, pamphlet, cassette, offset, silhouette, technocrat, robot , carpet, boycott, mascot, spot, robot, delicate, merit, cornet	tense-/d/

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