Phonotactic Adaptation in Loanwords: Insertion vs. Deletion

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Seo, Hongwon. (2016). Phonotactic Adaptation in Loanwords: Insertion vs. Deletion. *The Linguistic Association of Korea Journal, 24*(3), 37-62. The goal of this paper is to investigate what repair strategies can be employed when an illegitimate cluster is adapted into a language which lacks complex margins and how a typology can be dealt with within the framework of the Optimality Theory. Vowel insertion is cross-linguistically preferable over consonant deletion. This tendency is well supported by TCRS (Paradis & LaCharité 1997), but if more than one repair is necessary, deletion inevitably happens depending on perceptual salience and similarity. Concerning the position of vowel insertion, three types are all observed in loanword adaptation: only prothesis, only anaptyxis, and a mixed pattern. For the OT analysis, the ranking permutation between SyllCon and Contiguity can account for such an asymmetrical typology, in combination with some markedness constraints to comply with phonological restrictions.

Key Words: loanword, insertion, deletion, phonotactic adaptation, perceptual similarity

1. Introduction

Loanwords are usually referred to as words that are directly or indirectly borrowed from other source languages and then incorporated into a target language without any translation. Almost every language has a considerable number of loanwords borrowed from other languages due to the consequences of languages coming in contact to each other. However, in the borrowing process, loanwords should be inevitably filtered through native phonology, and meanings are also assigned to them in terms of how they could be understood

by native speakers. Above all, from the phonological perspective, loanwords, whose phonological structure does not fit into or is not compatible with native phonology need to be adapted to it.

Until now, much attention has been paid to research on loanword phonology since the advent of constraint-based approaches like the Optimality Theory (hereafter, OT) (Prince & Smolensky 1993, 2004) and Correspondence Theory (McCarthy & Prince 1995). Under the framework of OT, loanword adaptation can be easily accounted for by adjusting the ranking order of constraints. In addition, in the loanword adaptation processes, the unanticipated emergence of patterns, which are not attested in the phonology of the borrowing language, has still made many scholars have much interest in loanword phonology. As Smith's study (2006) presents, loanword adaptation shows demonstrably different patterns from native language phonology. For example, whereas a default strategy to repair complex consonant clusters within a syllable in Korean and Japanese native phonology is deletion, epenthesis is more preferred to deletion in loanword adaptation processes. In this vein, Kang (2011) adds that loanword adaptation might provide some clues to resolve completely unanswered grammatical knowledge which native data alone cannot.

Loanwords should go through adaptation processes to conform to the legitimate phonological restrictions of a native language. In such adaptation processes, borrowed words, which have different phonemic inventories or syllable structures from a native language, are naturally forced to significantly modify the phonological structures of source words, ranging from the segmental, phonotactic, and morpho-phonological structures to suprasegmentals like stress, pitch, and tone. Segmental adaptation, epenthesis, deletion, and neutralization are a few leading ways that can be done to solve some phonological conflicts. When it comes to such preferred strategies, Paradis & LaCharité (1997, 2005) suggest that even ill-formed segments be preserved and adapted as much as possible, unless the cost of segment insertion is too high. From the perspective of Theory of Constraints and Repair Strategy Loanword Model (henceforth, TCRS) (Paradis & LaCharité 1997), they argue that segmental epenthesis should be a lot more preferred over illegitimate segment deletion to retain the input maximally within the limits of the threshold. In other words, the Preservation Principle is not kept only when more than two steps or repairs are required to

be applied.

With respect to the Preservation Principle, a few important questions can arise. First, why are certain repair strategies like vowel insertion more widely attested across a range of source languages? Second, under what phonological circumstances can deletion be chosen as a repair strategy, rather than segmental adaptation or insertion? In particular, it should be dealt with whether the segment position or its phonetic salience of borrowings has something to do with the choice of repair strategies, as well. According to Beckman's statement (1997), phonological segment deletion or modification is much less preferable in the privileged positions due to the requirement to positional faithfulness identity. Given that some disparity exists in terms of positional faithfulness, it might be possible to predict that segments in the onset position will be likely to be deleted less than those in the coda position. Furthermore, if vowel insertion is the most available repair option in loanword adaptation, we may need to identify which vowels are inserted and on which those vowels can be posited. Fleischhacker (2005) claims that the position of vowel insertion is closely relevant to vowel quality. With respect to such a close interaction between vowel position and quality in loanword vowel insertion, Broselow (2015) also presents some evidence that while an invariantly default vowel is usually inserted before clusters, the inserted vowel between clusters tends to be contextually determined in many languages.

In this study, accordingly, we will consider how phonotactic adaptation in loanwords can be accounted for in an OT analysis in order to recapitulate the questions raised earlier, while looking into what effect TCRS has on loanword adaptation processes. Also, we will try to investigate how a vowel can be inserted for the nativization of borrowed words.

The structure of this paper is organized as follows. In section 2, we will provide an overview of previous studies in which the Preservation Principle is highly emphasized. Section 3 will provide a description of the data and look into what repair strategies are cross-linguistically implemented to adapt ill-formed segments. In section 4, we will present the analysis showing how some languages adapt English words into their languages based on a perspective of OT. Finally, section 5 will present the main conclusion with some implication for the future study.

2. Literature Review

In this section, we will briefly review theoretical approaches to support the Preservation Principle that the input of borrowed words should be maintained in borrowings as much as possible (Paradis & LaCharité 1997). We should note that as Smith (2006) indicates, what Preservation means cannot be regarded the same as Similarity, in that segmental insertion can also cause phonological dissimilarity as deletion can. Even in OT terms, any violation of both constraints, DEP (No insertion) and MAX (No deletion) equivalently means to incur faithfulness violations.

Paradis & LaCharité (1997) suggest the TCRS framework to show the predictability of phonological adaptation, segment preservation and deletion in borrowings, illustrating adaptations of French loanwords in Fula.

TCRS can be schematized and summarized as shown in (1) and (2) (Paradis & LaCharité 1997: 384-387):

(1) TCRS Model

Constraint Violation
↓
Repair (insertion or deletion)

Governed by the
Preservation Principle (limited by the Threshold Principle)
Minimality Principle (based on the PLH)
Precedence Convention (based on the PLH)

(2) Principles and Conventions

a. Repair Strategy

A universal, non-contextual phonological operation that is triggered by the violation of a phonological constraint and which inserts or deletes content or structure to ensure conformity to the violated constraint.

b. Preservation Principle

Segmental information is maximally preserved within the limits of the Threshold Principle.

c. Threshold Principle

All languages have a tolerance threshold to the amount of repair needed to enforce segment preservation. This threshold is the same for

all languages: two steps within a given constraint domain.

d. Minimality Principle
A repair strategy must be applied at the lowest phonological level to which the violated constraint refers. Repair must involve as few strategies as possible.

e. Phonological Level Hierarchy (PLH)
Metrical level > syllable level > skeletal level > root node > feature with a dependent > feature without a dependent

f. Precedence Convention
In a situation involving two or more violated constraints, priority is given to that constraint referring to the highest phonological level of the PLH.

As given in (1) and (2), when ill-formed words are borrowed into a target language, some repairs must inevitably be done to comply with native phonology. Paradis & LaCharité (1997) argue that even ill-formed segments should be retained to adhere to the Preservation Principle as closely as possible in the borrowing process, by either adjusting them or inserting an additional segment. Segments can be deleted only when adaptation cannot tolerate the Threshold Principle. Put simply, during the process of the adaptation of loanwords, the phonological structure should be preserved maximally and be repaired minimally. Thus, deletion can apply when more than two steps or repairs are required to be adapted within a constraint domain. The Minimality Principle requires that repairs should the most economically be applied with as few means as possible. When determining priority among two or more violated constraints, the lowest phonological level takes precedence over other phonological levels according to PLH.

Let us consider how TCRS accounts for segmental adaptations of French loanwords in Fula. As shown in (3), no voiced fricative exists in Fula, which makes a voiced fricative /v/ adapted into the sounds like /w, b, f/.

(3) Adaptation of /v/ in Fula[1] (Paradis & LaCharité 1997)

a. Parameter			French	Fula
Voiced fricative? (*[+continuant][+voice] without [+sonorant])			YES	NO (*v, *z, *ʒ)
b. French		Fula		
avocat	[a**v**ɔka]	→ a**w**ɔka	'lawyer'	*v→w (76.5%)
livre	[li**v**r]	→ li:**b**a:r	'look'	*v→b (17.3%)
mouvement	[mu**v**mã]	→ mu**f**maŋ	'movement'	*v→f (6.2%)

Along with the constraint in (3a), consonant clusters are not permitted in Fula, and branching onsets or codas, accordingly, should be ruled out. Borrowed French words having an excess of consonants should undergo segment deletion or insertion. As the Preservation Principle predicts, the latter is the more preferred repair strategy. Thus, vowel insertion or vowel (or glide) spreading could be completely predictable since only one repair can solve malformation within the limit of the Threshold Principle.

(4) Adaptation of consonantal clusters in Fula (Paradis & LaCharité 1997)

a. Parameter			French	Fula
Branching non-nucleus?			YES	NO
b. French		Fula		
classe	[**kl**as]	**ka:l**as	'class'	
boisson	[**bw**asɔ̃]	**buw**asɔŋ	'drink'	
statue	[**st**aty]	**ist**ati	'statue'	

However, some French words could be problematic when loaned into Fula as they violate two constraints simultaneously. As given in (5), some borrowed French words consist of an ill-formed cluster and such each cluster contains an illicit segment. Thus, it is essential that three-step repairs such as nucleus insertion, glide spreading, and *v adaptation should be done to satisfy the

1) Among the data from a corpus of 545 French loanwords in Fula, the number of French words containing /v/ is 99, out of which 81 words show its adaptation into Fula. However, /v/ is not adapted or deleted in 9.1%, respectively.

phonological structure in Fula. As it leads to the violation of the Threshold Principle not allowing more than two repairs, deletion inevitably occurs at the expense of segment insertion despite the violation of the Preservation Principle.

(5) Adaptation of /v/ in consonant clusters in Fula (Paradis & LaCharité 1997)

French		Fula		
voyou	[**vw**aju]	**w**aju	*wuwaju	'bum'
voyage	[**vw**aja3]	**w**aja:s	*wuwaja:s	'trip'

Until now, we have considered how the TCRS loanword model plays a significant role in selecting a repair strategy in the process of loanword adaptation. In this model, all phonological input should be preserved as maximally as possible and be repaired as minimally as possible. Thus, deletion which is more costly than insertion is likely to occur at a very low rate. However, a few counter-examples are not explainable with only TCRS and are attested in various languages. In the following section, we will present some data repaired by deletion, not by insertion, and we will also account for what factors make such a non-universal repair strategy employed under Correspondence Theory (McCarthy & Prince 1995) within the framework of OT.

3. Data and Description

Languages not permitting consonantal clusters should necessarily undergo some phonotactic adaptation process to comply with native language restrictions. In particular, when consonant clusters cannot be incorporated into a well-formed syllable, vowel insertion or consonant deletion can be employed to achieve exhaustive segmental syllabification in the process of illegitimate cluster nativization. However a predominantly available repair is vowel insertion over consonant deletion, resyllabifying a cluster into separate syllables. In section 3.1, we will look into whether vowel insertion is actually a more preferred strategy over consonant deletion in order to comply with native phonology. Given that consonant insertion is preferred to deletion, it should be dealt with what factors lead to consonant deletion. For the analytical

convenience of loanword adaptation patterns among languages, we will present data chiefly borrowed from English into each language. In section 3.2, we will also take into consideration of how a vowel can be inserted with respect to the position.

3.1 Phonotactic Adaptation: Vowel Insertion vs. Consonant Deletion

At first, let us consider how a repair strategy employed in loanword adaptation differs from a language-internal phonological repair strategy. If Japanese verb roots end in consonants before a consonant-initial suffix, as the non-past and causative forms given in (6), the initial consonant of suffixes is deleted since Japanese does not commonly permit codas. Even in Korean, likewise, when morphemes ending in a consonant cluster underlyingly appears before a vowel, the last consonant is resyllabified in the following onset; otherwise, consonant cluster reduction should be applied to conform to the (C)(G)V(C) template in Korean. This is shown in (8). However, in the loanword adaptation process of both Japanese and Korean, a totally different repair strategy, vowel insertion, is used to resolve illicit codas or clusters. The examples in (7) and (9) show that consonant retention of source words is much more cross-linguistically preferred to its deletion in loanword adaptation. In sum, deletion is employed in host languages, but epenthesis for the segment retention is chosen as a repair strategy in loans.

(6) Affixation in Japanese (McCawley 1968, cited in Smith 2006)

			non-past /-rɯ/		causative /-sase/	
a.	/mi/	'see'	/mi+rɯ/	[mi.rɯ]	/mi+sase/	[mi.sa.se]
b.	/tabe/	'eat'	/tabe+rɯ/	[ta.be.rɯ]	/tabe+sase/	[ta.be.sa.se]
c.	/jom/	'read'	/jom+rɯ/	[jo.mɯ]	/jom+sase/	[jo.ma.se]
d.	/tob/	'fly'	/tob+rɯ/	[to.bɯ]	/tob+sase/	[to.ba.se]

(7) English loanwords in Japanese (Lovins 1975, cited in Smith 2006)

a.	[gɯ.ri:n]	'green'
b.	[sɯ.ka.rɯ]	'skull'
c.	[sa.rɯ.be:.ʤi]	'salvage'

(8) Consonantal cluster simplification in Korean

a.	/kaps/	[kap]	'price'
	/kaps+i/	[kap.si]	'price+nominative'
	/kaps+kwa/	[kap.k'wa]	'price+and'
b.	/ilk+ta/	[ik.t'a]	'read+declarative'
	/ilk+ɨl/	[il.gɨl]	'read+objective'

(9) English loanwords in Korean

a.	[sɨ.k^{h}ul]	'school'
b.	[pɨ.rə.si]	'brush'
c.	[a.i.sɨ]	'ice'
d.	[t^{h}en.t^{h}ɨ]	'tent'

When it comes to the position of clusters, Kang (2011) indicates that a vowel insertion repair strategy is more predominantly used to eliminate ill-formed clusters in word-initial position, compared with word-final position. She adds that there are few languages only employing a deletion strategy word-initially, most of which are creole languages, except Finnish. Should languages use deletion strategies word-initially, they are generally combined along with epenthesis strategies[2].

We will now turn to how the target of deletion is determined according to languages. Segments in /s/-initial clusters are usually preserved by vowel insertion, while obstruent-liquid clusters may be simplified and repaired by deleting the second consonant. With respect to deletion, Yip (2002) argues that relative acoustic salience in the perception plays a crucial role in determining the target for deletion. In particular, she tries to divide each segment into three levels at the stage of the preceptual scan, directly based on perceptual salience: undetected segments, highly salient segments, and less-salient segments. She adds that highly salient segments like /s/ can be detected so easily that they all must be preserved. However even though less salient ones like liquids are detected, they are not assigned as their own syllable nodes. Thus it might allow Cantonese speakers to perceive clusters as a simple segment or not to perceive liquids. Extending Yip's suggestion, Fleischhacker (2005) also explains why obstruent and liquid onsets are simplified through deletion rather than

2) As for languages showing deletion repairs in word-initial clusters, see Kang (2011: 2272).

vowel insertion. She suggests that deleting a liquid sounds very similar to its source form because the perceptual difference between O_1R_2V and O_1V is not great[3] (O=obstruent, R=sonorant, S=sibilant fricative, V=vowel). According to her similarity scales about consonant deletion and vowel insertion, the perceptual difference between O_1R_2V and O_1V is particularly smaller than that between C_1C_2V and C_1V or C_1C_2V and C_2V, which might incur liquid deletion. Concerning salience, Fay and Culter (1977) also argue that liquids have vowel-like formants acoustically, and as a result, cannot be easily distinct from neighboring vowels saliently. This lack of perceptual salience might make them relatively susceptive to deletion.

From the perspective of a perceptual approach, Côté (2000), likewise, tries to deal with consonant cluster phonotactics arguing against traditional syllabically conditioned analyses. She argues that consonant deletion and vowel epenthesis are all motivated by the principle of perceptual salience. In other words, the possibility that a consonant deletes or a vowel is inserted is correlated with the quality and quantity of the auditory cues. When the perceptual cues of a consonant that allow a listener to detect its presence are not great, deletion occurs. On the contrary, vowel epenthesis supplies segments with the needed additional salience.

Let us consider how acoustic salience of segments plays an important role in adaptation of English words into Cantonese.

(10) English loanwords in Cantonese (Yip 2002)

a.	[si:.tʰa:m]	'stamp'
b.	[si:.pa:la:]	'spanner'
c.	[fi:.sa:]	'freezer'
d.	[pow.lɐm]	'plum'

3) Fleischhacker (2005) argues that a liquid sometimes deletes when the result of deletion is perceptually similar to intact clusters in some phonological processes such as loanword adaptation and reduplication. In addition to liquid deletion in loanwords above, some reduplicative patterns, also, exceptionally show $O_1R_2V \rightarrow O_1V$ copying; otherwise $C_1C_2V \rightarrow C_1C_2V$ copying. Furthermore, we can also observe that /r/ in onset position of an unstressed syllable is optionally deleted in English words like *céleb[r]atòry*, *p[r]opórtional*, and *p[r]onóunce*.

As given in (10a, b), /s/-intial clusters always undergo epenthesis to retain all segments, rather than deletion. With respect to this phenomenon, Côté (2000) argues that stridents like /s/ and /ʃ/ are closely associated with the noise of high amplitude, perceptually detectable with ease, which makes them militate against deletion. Such a perceptually motivated explanation is obviously in keeping with deletion of less perceptual consonants in the context composed of a consonant and a liquid. English liquids can be deleted when not violating the minimal word requirement that a loanword must be minimally bisyllabic in Cantonese. That is, although less salient segments like liquids can be deleted to repair illicit clusters, vowel epenthesis must be employed not to violate the minimal word requirement, like (10d). Such asymmetric repair strategies that /s/-initial clusters are broken up by epenthesis, but obstruent + liquid clusters are borrowed with deletion of liquids are also attested in a few other languages such as Mandarin, Vietnamese, and Thai.

However, we should note that all languages with a deletion repair do not show the same way as Cantonese when choosing the target segment to be deleted. For example, languages like Hawaiian lacking /s/ in the phonemic inventory delete /s/ in /s/-initial clusters, while other clusters are all retained by epenthesis, as given in (11). English loans in Hawaiian do not tolerate /s/ in clusters, although pre-consonantal /s/ is quite salient for many languages. Owing to the absence of /s/ in the Hawaiian phonemic inventory, retaining it requires more than a repair step to be involved, which incurs violation of the Threshold Principle in TCRS suggested by Paradis & LaCharité (1997). In this respect, /s/ deletion within clusters is a lot more economical than undergoing its substitution into other sounds and vowel insertion.

In Telugu, a Dravidian language, we can observe somewhat different variation patterns between epenthesis and deletion. Both epenthesis and deletion can be employed as repair strategies of complex onset clusters. But, when consonant deletion is engaged, the more sonorous segment deletes: a liquid in obstruent and liquid clusters and /s/ in /s/-intial clusters, as given in (12).

(11) English loanwords in Hawaiian (Elbert & Pukui 1979, Adler 2006)

a.	[ku.la]	'school'
b.	[pa.la.ki]	'brush'
c.	[kə.ˊpi.kə] or [ˊpi.kə]	'speak'

(12) English loanwords in Telugu (Fleischhacker 2005)

a.	[ga.su] or [ga.la.su]	'glass'
b.	[te.ʃə.nu] or [is.te.ʃə.nu]	'station'

From the two language adaptation patterns above, it is implied that perceptual salience is a highly significant, but not an absolute factor when determining which segments would be deleted. The two cases are each conditioned by specific internal language grammar, not a perceptual motivation. Likewise, Jacob & Gussenhoven (2002) argue that the degree of salience could be clearly language-specific, illustrating how English segments considered non-salient in Cantonese are readily perceived and adapted into Dutch.

Until now we have examined how illicit clusters in word-intial position or onset position are adapted into borrowing languages. Now, we will briefly note how consonant clusters can be loaned in word-final position or coda position. Compared to word-initial position, a priority is not given to vowel epenthesis for coda clusters. It means that the universally cross-linguistic preference for vowel insertion over consonant deletion does not totally spread out to clusters in word-final position. This asymmetric pattern considerably fits in with the positional faithfulness identity (Beckman 1997) that segments in privileged positions have the same identity between corresponding input and output. In other words, segments in non-privileged positions like coda or word-final position are more vulnerable to deletion or phonological adaptation than those in privileged positions. It is also supported by the 'Licensing of Cue' approach (Steriade 1997) or P-map Theory (Steriade 2009) that segments with more salient perceptual cues are less likely to be deleted than those with less salient cues[4].

In the next subsection, we will deal with where a vowel is chosen to be

4) We will not consider asymmetries between the adaptation of initial and final clusters, which are beyond the scope of this paper,

inserted and what factors play a crucial role in determining the position of vowel insertion.

3.2 The Position of Vowel Insertion in Loanword Adaptation

When foreign words with consonant clusters are taken into a language, which lacks a complex cluster, the most common strategy to repair into conformity with native phonotactics is vowel insertion to resyllabify the cluster into separate syllables. Given that even biconsonantal clusters allow a vowel to be inserted in two possible sites, systematic investigation on where to insert should be taken into consideration.

As shown below, possible positions for vowel insertion are either between clusters (anaptyxis) or in front of the first consonant (prothesis). However, languages, which lack codas, permit vowel insertion only in non-prevocalic position like (13a); otherwise most borrowing languages should determine an appropriate insertion site of two potential positions.

(13) Position of inserted vowels (_ indicates a position for vowel insertion)
  a. C_1_.C_2V
  b. _C_1.C_1V

With respect to the typology of vowel insertion patterns, Broselow (2015) classifies languages into three types: only prothesis, only anaptyxis, and mixed patterns[5].

First, only two languages such as Iraqi Arabic and Central Siberian Yupik show consistent prothesis before clusters, regardless of any cluster types. As illustrated in (14), a vowel is inserted before clusters in English loanwords. The restriction on word medial triconsonantal clusters in Iraqi Arabic causes a vowel to be inserted after /s/.

5) Concerning the typology for anaptyxis and prothesis patterns in loanword adaptation, see Broselow (2015: 308-309).

(14) English loanwords in Iraqi Arabic (Broselow 1983)

a.	[isno:]	'snow'
b.	[istadi]	'study'
c.	[sitrit]	'street'

The second type is a mixed pattern. Even languages permitting prothesis, most of which show mixed patterns, which can be easily predicted based on cluster types. Broselow (2015) finds that lots of languages show consistent patterns that the position of an inserted vowel is dependent on the cluster type. In other words, canonical anaptyxis and prothesis asymmetries are observed: prothesis before /s/-obstruent clusters and anaptyxis elsewhere[6]. As given in (15), prothesis appears before a /s/-stop cluster while onset clusters with rising sonority undergo anaptyxis. In particular, a vowel is inserted before a /s/-stop cluster along with /ʔ/ insertion, as a vowel initial syllable is not allowed in Cairene Arabic.

(15) English loanwords in Cairene Arabic (Broselow 1983, 2015)

a.	[firiizar]	'freezer'
b.	[silajd]	'slide'
c.	[ʔiskii]	'ski'
d.	[ʔispriŋ]	'spring'

With respect to this asymmetry, Fleischhacker (2005) argues that the position of vowel insertion is chosen to maximize the perceptual similarity between borrowed and borrowing languages. She presents the perceptual experimental result that ORV and O_RV is similar than ORV and _ORV, while STV and _STV is more similar than STV and S_TV. Broselow (2015) suggests that listeners tend to perceive an illusory vowel in clusters which are not legitimate in their native language. Such tendency to misperception has an impact on loanword adaptation, which makes listeners misperceive OR as O_R, separated by an intervening vowel.

Broselow (2015) indicates that the position of inserted vowels and their

6) The mixed type of $\_T_1R_2V$ and $S_1\_T_1V$ has not been attested until now.

quality are closely interacted in many languages. Only two of the four possible interactions between the mixed patterns and the quality of inserted vowels are attested: a default vowel in both positions and a copy vowel within a cluster, but a default vowel before the cluster.

Finally, there are lots of languages absolutely favoring anaptyxis over prothesis. Many languages including Korean and Japanese actually show only an anaptyctic pattern. All illegal intial clusters are repaired by vowel insertion within a cluster, irrespective of a cluster type.

(15) English loanwords in Korean

a.	[pɨ.rə.si]		'brush'
b.	[sɨ.no.u]	*[ɨs.no.u]	'snow'
c.	[sɨ.p^{h}at]	*[ɨs.p^{h}at]	'spot'

As given above, Korean permits only vowel insertion between clusters, but not before clusters. In Korean, prothesis is prohibited before OR clusters by Syllable Contact, banning a coda-onset sequence with rising sonority between neighboring syllables. Also, if prothesis appears in front of /s/-clusters, /s/, which is restricted by Coda Condition in Korean, must undergo an additional feature change. Considering the Preservation and Minimality Principles (Paradis & LaCharité 1997) that phonological structure should be preserved maximally and repaired minimally, only anaptyxis should be applied in Korean.

So far we have considered what factors the position of an inserted vowel is dependent on, focusing on adaptation of English words into each language. We found that the position of vowel insertion is closely related with the phonological restriction of a native language and the perceptual similarity between source and target languages. In the following section, we will provide an optimality-theoretic analysis on phonotactic adaption in loanwords.

4. An Optimality-theoretic Account

In this section, we will account for how languages, which lack consonantal clusters, must undergo phonotactic adaptation to comply with native phonology

within the framework of OT. At first, some markedness constraints are necessary to satisfy the legitimate syllable structure or phonological restriction in each language.

(16) a. *COMPLEX: No complex syllable margins.
b. SYLLCON: Sonority must not rise across a syllable boundary. (Vennemann 1988)

Complex onsets or codas are universally more marked as compared to simple syllable margins, and many languages actively avoid complex onsets and codas. Vowel insertion and consonant deletion are typical avoidance strategies for the prohibition on complex consonant clusters, and can be controlled by *COMPLEX. While *COMPLEX allows the split into two syllables by vowel insertion or consonant deletion, SYLLCON determines the position of vowel insertion, along with the faithfulness constraint, CONTIGUITY, illustrated below. There is a cross-linguistically preference for syllable contacts requiring that sonority must not rise across a syllable boundary. SYLLCON can dictate asymmetries for the site of vowel insertion differently: prothesis before /s/-obstruent clusters and anaptyxis elsewhere. The function of SYLLCON is to permit vowel insertion before /s/-obstruent clusters, but to block prothesis elsewhere, which leads to the non-optimal sequence of consonants with rising sonority.

To satisfy *COMPLEX, the strategies which can be employed are to delete one of the segments or to insert a segment. Thus, we need some faithfulness constraints, which militate against divergence between input and output. Consonant deletion violates MAX-C and vowel epenthesis violates DEP-V, respectively. Another constraint, CONTIGUITY is similar to two faithfulness constraints in that it too refers to the correspondence relations between input and output segments. Both insertion and deletion interact with contiguity as follows: if output contains an additional segment not present in input, it intervenes a contiguous string; while in the case of deletion, segments are separated in the output, as compared to input. If anaptyxis emerges in a language, CONTIGUITY must dominate DEP-V to cause vowel epenthesis within clusters.

(16) a. DEP-V: Every vowel of the output has a correspondent in the input.
b. MAX-C: Every consonant of the input has a correspondent in the output.
c. CONTIGUITY: Segments contiguous in the input must be contiguous in the output.

Finally, additional constraints should be employed to regulate the well-formed syllabification of each language.

(17) a. ONSET: Syllables must have onsets.
b. SEGMARKED: Non-existent segments in the phonemic inventory are prohibited.
c. CODACON: Restriction on coda consonants should be kept.

ONSET requires that syllables must not begin with a vowel and the presence of an onset is an unmarked situation as compared to its absence. A markedness constraint, SEGMARKED disallows illicit segments to appear in a syllable and demands them to be deleted or changed to comply with legitimate phonotactic requirements. CODACON refers to the restriction on the place of articulation or the consonants permitted in coda position. For example, in Japanese a coda cannot license place features, and CODACON militates against codas having independent place of articulation. In Korean, however, CODACON requires that only unreleased segments /p, t, k, m, n, ŋ, l/ be allowed in coda position.

A typology triggered to avoid complex margins arises on the basis of ranking hierarchies of DEP-V and MAX-C.

(18) Strategies triggered to avoid complex margins
a. *COMPLEX 》 MAX-C 》 DEP-V (No deletion)
b. *COMPLEX 》 DEP-V 》 MAX-C (No insertion)

The highest-ranked constraint, *COMPLEX determines the avoidance of complex clusters at the expense of violations of DEP-V and MAX-C. When a priority is given to MAX-C over DEP-V, vowel insertion successfully repairs syllable ill-formedness. When the ranking is reverse, avoidance of complex

margins can be achieved by consonant deletion, rather than epenthesis.

As stated in the previous section, however, vowel epenthesis is the cross-linguistically preferred repair strategy, and furthermore, even in most languages using a deletion strategy typologically, repairs tend to be done in combination with epenthesis. When it comes to which segments are prone to deletion in which environment, perceptual salience usually plays a crucial role in determining a target for deletion. Cross-linguistically, less salient segments are likely to be deleted, which causes MAX-C to be decomposed into MAX-C (STRIDENT), MAX-C (OBSTRUENT), and MAX-C (LIQUID)[7]. Considering this asymmetry of segment salience within clusters, the constraint MAX-C can be recapitulated as follows:

(19) MAX-C (STRIDENT) ⟫ MAX-C (OBSTRUENT) ⟫ MAX-C (LIQUID)

Accordingly, we should also note that in languages such as Cantonese and Vietnamese, repairs can be applicable by the following modified ranking: MAX-C (OBSTRUENT) ⟫ DEP-V ⟫ MAX-C (LIQUID). Let us compare how illicit segments can be adapted by using two different repair strategies, epenthesis and deletion, respectively, as given in the following tableaux:

Tableau 1. English loanword adaptation into Cantonese

/stamp/ → [si:.tʰa:m] 'stamp'

/stamp/	*COMPLEX	MAX-C(OBSTRUENT)	DEP-V	MAX-C(LIQUID)
a. [stʰa:m]	*!			
☞ b. [si:.tʰa:m]			*	
c. [tʰa:m]		*!		
d. [sa:m]		*!		

7) From the perspective of perceptual salience, instead of using MAX-C (LIQUID) or MAX-C (STRIDENT), Yip (2002) suggests MIMIC-SALIENT requiring that salient segments should not delete. However, her suggestion has some drawbacks not available to account for languages like Hawaiian or Telugu. Although a segment is very salient in a source language, it cannot be adapted into a language not permitting the segment in the phonemic inventory. For example, as /s/ is not permitted in Hawaiian, and thus /s/ must be adapted into Hawaiian with it deleted or replaced into other segment.

Tableau 2. English loanword adaptation into Cantonese

/frizə/→ [fi:sa:] 'freezer'

/frizə/	*COMPLEX	MAX-C(OBSTRUENT)	DEP-V	MAX-C(LIQUID)
a. [fl:.sa:]	*!			
b. [fi:.li:.sa:]			*!	
☞ c. [fi:.sa:]				*
d. [li:.sa:]		*!		

As illustrated in tableaux 1 and 2, ill-formed clusters adapted into Cantonese can be rescued by two repairs, which means deletion and epenthesis are both employed. In order to account for this disparity within a language, reranking between MAX-C and DEP-V is necessarily required. In tableau 1, a complex onset can be resolved by inserting a vowel within a cluster, in spite of incurring the violation of DEP-V. However, as Yip (2004) indicates a post-consonantal stop in word-final position is never detected at all, /p/ does not survive. In the case of tableau 2, consonant deletion contributes to the improvement of an illicit cluster. Candidate (2a) is first eliminated by *COMPLEX. Since a liquid having less salience than other consonants is less detected, candidate (2c), which violates MAX-C (LIQUID) is chosen as a more optimal form than candidate (2d).

If a segment does not exist in the phonemic inventory of a native language, it inevitably either undergoes deletion or is substituted into another segment. For example, as /s/ does not exist in Hawaiian, when English words with it are adapted, it inevitably either undergoes deletion or is substituted into the most unmarked consonant, [k]. As indicated earlier, irrespective of its high perceptual salience, /s/ is usually omitted in loans of Hawaiian, which can be easily dealt with by the undominated constraint, SEGMARKED, or more specified */s/, requiring that non-existent segments in the phonemic inventory do not emerge.

Let us now turn to how typological patterns related to the position of vowel insertion in loanwords can be accounted for under OT analyses. As Broselow (2015) classifies, three types are attested in natural languages: only prothesis, only anaptyxis, and mixed patterns. A factorial typology of vowel insertion arises on the basis of the ranking permutation of CONTIGUITY and ONSET with respect to SYLLCON. *COMPLEX remains undominated throughout the factorial

typology. Of course, in the case of languages without codas, **SyllCon** does not have any direct role in selecting the optimal output, only anaptyxis is applicable.

(20) Constraint rankings with respect to the position of vowel insertion

a. Languages permitting only prothesis (Iraqi Arabic)
*Complex 》 **Contiguity** 》 **SyllCon, Onset** 》 Max-C 》 Dep-V

b. Languages permitting only anaptyxis (Korean)
*Complex 》 **Onset, SyllCon** 》 **Contiguity** 》 Max-C 》 Dep-V

c. Languages permitting prothesis before /s/-O clusters and anaptyxis elsewhere (Cairene Arabic)
*Complex 》 **SyllCon** 》 **Onset** 》 **Contiguity** 》 Max-C 》 Dep-V

Let us consider the analysis of English adaptation into Iraqi Arabic permitting only prothesis. As illustrated in tableau 3, candidate (c) is first removed by violating the undominated constraint, *Complex. Second, Contiguity, militating against vowel intrusion or consonant deletion within a cluster as strategies to repair ill-formed clusters fulfills an important role in ruling out candidates (3a, b, e). Finally, candidate (3d) preserves a contiguous string at the expense of violating SyllCon and survives as an optimal output.

Tableau 3. English loanword adaptation into Iraqi Arabic

/sno/→ [isno:] 'snow'

/sno/	*Complex	Contiguity	SyllCon	Onset	Max-C	Dep-V
a. [so:]		*!			*	
b. [no:]		*!			*	
c. [sno:]	*!					
☞ d. [is.no:]			*	*		*
e. [si.no:]		*!				*

Unlike languages permitting only prothesis, languages such as Korean and Japanese only allow a vowel to be inserted within a cluster. As given in tableaux (4) and (5), both optimal forms are obtained by anaptyxis, irrespective of a type of onset clusters. Although leaving a medial gap, which incurs the violation of Contiguity, anaptyxis is well motivated to satisfy *Complex and

ONSET. In other words, two tableaux show that each optimal output results from the domination of SYLLCON over CONTIGUITY, and the emergence of the unmarked, the preference to onsets.

Tableau 4. English loanword adaptation into Korean[8)]

/sno/→ [si.no.u] 'snow'

/sno/	*COMPLEX	ONSET	SYLLCON	CONTIGUITY	MAX-C	DEP-V
a. [no.u]		*		*	*!	
b. [sno.u]	*!	*				
c. [ɨs.no.u]		**!	*!			*
☞ d. [si.no.u]		*		*		*
e. [ɨt.no.u]		**!	*!			*

Tableau 5. English loanword adaptation into Korean

/spat/→ [si.p^{h}at] 'spot'

/spat/	*COMPLEX	ONSET	SYLLCON	CONTIGUITY	MAX-C	DEP-V
a. [p^{h}at]				*	*!	
b. [sp^{h}at]	*!					
c. [ɨs.p^{h}at]		*!				*
☞ d. [si.p^{h}at]				*		*
e. [ɨt.p^{h}at]		*!				*

Next observe how a cluster can be adapted into Cairene Arabic. As stated earlier, prothesis is done before a cluster consisting of /s/ and an obstruent while anaptyxis happens elsewhere. Tableau 6 shows an example showing anaptytxis. First, candidates (6c) and (6e) violate fatal *COMPLEX and SYLLCON, respectively, and both of them are eliminated. Among remaining candidates, we leave out (6a) and (6b), both of which undergo consonant deletion, rather than vowel insertion. On the contrary, in tableau 7 with an /s/-O cluster, candidate (7d) adding a consonant as well as a vowel is selected as an optimal output, by ONSET enforcing a consonant to appear at the beginning of a word in Cairene Arabic, although it violates an additional constraint, DEP-C. Concerning consonant addition, a little inconsistent pattern between Korean and Cairene

8) Candidate (4c) and (5c) can be eliminated by the markedness constraint, CODACON which only permits 7 codas in Korean.

Arabic is attested, since only Korean authorizes a syllable without an onset at the word-initial position. Given that this disparity, the relative ranking hierarchy of DEP-C between two languages is totally different. In order to block the simultaneous application of vowel and consonant insertion in Korean, DEP-C outranks CONTIGUITY, and vice versa in Cairene Arabic

Tableau 6. English loanword adaptation into Cairene Arabic

/frizə/→ [firiizar] 'freezer'

/frizə/	*COMPLEX	SYLLCON	ONSET	CONTIGUITY	MAX-C	DEP-V
a. [fiizar]				*	*!	
b. [riizar]				*	*!	
c. [friizar]	*!					
☞ d. [firiizar]				*		*
e. [ifriizar]		*!	*			*

Tableau 7. English loanword adaptation into Cairene Arabic

/ski/→ [?iskii] 'ski'

	*COMPLEX	SYLLCON	ONSET	CONTIGUITY	MAX-C	DEP-V	DEP-C
a. [sii]				*!	*		
b. [skii]	*!						
c. [iskii]			*!			*	
☞d. [?iskii]						*	*
e. [sikii]				*!		*	

In this section, we have provided the constraint-based analyses concerning how languages lacking complex consonants adapt such illicit clusters into conformity with native phonological restrictions, and how a typology can be dealt with. In particular, in the languages showing deletion combined with insertion, perceptual salience and perceptual similarity play an important role in determining which segment is retained and deleted. We have also considered that many languages have a stronger preference for vowel insertion to consonant deletion and attested three types of vowel insertion: only prothesis, only anaptyxis, and mixed patterns. As illustrated earlier, this typology can be accounted for by the interaction between SYLLCON and CONTIGUITY.

The final section of this study will summarize what we have considered

and will present some conclusions and implications.

5. Conclusion & Implication

In this study we have investigated what repair strategies can be employed when an illegitimate cluster is adapted into a language. The strong preference for vowel insertion over consonant deletion is cross- linguistically observed. This tendency is well supported by TCRS (Paradis & LaCharité 1997). Note that most languages, in which deletion occurs, employ vowel insertion simultaneously, as well. Perceptual salience (Yip 2004) and perceptual similarity (Fleischhacker 2005) play a crucial role in determining which segment is deleted. The higher the salience of a segment, the more it is detected, which makes it remain untouched. Fleischhacker (2005) argues that a sonorant is more easily deleted in loanword adaptation since perceptual similarity between ORV and OV is greater than CCV and CV. However, if a segment does not exist in the native segment inventory, it is more likely to be deleted, since a non-existent segment requires more than a repair such as vowel insertion and segment substitution.

A typology for repair strategies can be calculated by the interaction D_{EP}-V and M_{AX}-C. When M_{AX}-C outranks D_{EP}-V, vowel insertion can successfully amend an ill-formed syllable, while the reversed ranking can recover a complex cluster by consonant deletion, rather than epenthesis. When dealing with languages with a deletion repair, the decomposed M_{AX}-C is additionally required depending on segment prominence.

When it comes to the position of vowel insertion, three types of typological patterns are attested: only prothesis, only anaptyxis, and mixed patterns. This asymmetrical typology is accounted for by the interaction among O_{NSET}, $S_{YLL}C_{ON}$, and $C_{ONTIGUITY}$. In languages which only permit prothesis, $S_{YLL}C_{ON}$ is not dominated by $C_{ONTIGUITY}$. Two other patterns show a reversed ranking hierarchy between two constraints, in combination with the markedness constraints, according to each language.

In sum, this study showed that epenthesis is cross-linguistically preferred to deletion due to the preservation and minimality principles and that beyond the

threshold, deletion can inevitably occur depending on perceptual salience or similarity. However, perceptual salience is not sufficient to tackle all languages, in that some languages do not follow the salience hierarchy and are controlled by each phonemic inventory. Accordingly, further studies should be conducted with respect to perceptual salience. Another interesting issue is how listeners could detect an invisible vowel when exposed to foreign words. Concerning an invisible input that a native speaker does not recognize, a perceptual experiment is worthy of being done.

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