Different adaptation patterns of English /f/ in Korean loanword phonology: Cases of direct borrowing and indirect borrowing

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Cho, Mi-Hui, and Lee, Shinsook. 2010. Different adaptation patterns of English /f/ in Korean loanword phonology: Cases of direct borrowing and indirect borrowing. *Studies in phonetics, phonology and morphology 16.2.* 259-277. This paper investigates the different adaptation patterns of English /f/ in Korean loanword phonology, employing Optimality Theory. In Korean loanword phonology, the target /f/ can be realized in various ways depending on borrowing sources: [p^h] in direct borrowing from English /f/ and/or [hw]/[hu] in indirect borrowing via Japanese /ɸ/. The same constraint ranking is posited to account for the various realizations of the target /f/ in both direct borrowing and indirect borrowing across different prosodic locations. Specifically, deviated forms from the target /f/ emerge because of the high-ranked markedness constraint of *Structure which prohibits segments that are not present in the Korean phonemic inventory. The realization of [hw]/[hu] in indirect borrowing via Japanese is accounted for by the constraint of Category preservation whereby the source /ɸ/ best matches to the Korean /h/ in terms of category. Category preservation is irrelevant for the realization of [p^h] in direct borrowing because there is no matching category in Korean for the target /f/. Further, it is shown that /f/ is realized as [hu] in word-initial onset position when the target /f/ occurs in a consonant cluster in the source language, due to the constraint OCP. It is also shown that the realization of /f/ as [p^{h}i] in word-final coda position can be accounted for by the generalized Release-to-vowel insertion constraint. **(Kyonggi University and Korea University)**

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1. Introduction

This paper examines the different adaptation patterns of English loanwords with the voiceless labiodental fricative in Korean. The English target /f/ is usually realized as the aspirated bilabial stop [p^h] in Korean. This is because the aspirated bilabial stop in Korean is the closest approximation to the English target /f/ in terms of place of articulation as well as the manner feature [spread glottis] (Iverson and Lee 2004).

There has been an extensive body of research on Korean loanword phonology, such as Iverson and Lee (2004), Kang (2003), and Oh (1996, 2002). Yet, most research focuses on the replacement of English targets,

and the insertion of vowels due to the differences of sound inventories and/or syllable structures between Korean and English. More recently, Iverson and Lee attempt to provide an account of the English consonant adaptations in Korean loanword phonology in terms of the 'salience' of the perceptual categories in the native language, thus emphasizing the role of perception in loanword phonology, similar to Kang.

Although Korean loanword studies try to deal with all aspects of Korean loanword phonology, they fail to notice that English /f/ can be realized in several different ways in Korean loanword adaptation. For example, Iverson and Lee, and Oh mention that English /f/ is realized only as the aspirated bilabial stop [pʰ]. However, /f/ can surface either as the aspirated bilabial stop [pʰ] or as the sequence of glottal fricative [hw]/[hu], as observed in Lee and Cho (2006) and Kang et al. (2008). Typically, /f/ in word-initial and word-medial onset locations is realized as [pʰ] as in words like *phone*, *fax*, and *sofa* whereas it sometimes emerges as [hw] as in words such as *fibe*r and *fence*. Moreover, the word-initial and word-medial onset target /f/ may have two outputs, [pʰ] and [hw], in some cases (e.g., *family, file, muffler*). Further, the realization of /f/ as [hw] shows variation depending on the quality of the following segments: When the target appears in a consonant cluster, [hw] is realized as [hu] as in words like *flavor* and *refresh*. In addition, /f/ in word-final coda position in the source language is always rendered as [pʰ]-plus-vowel (e.g., *knife* [naipʰɨ], *soft* [sopʰɨtʰɨ]). That is, the coda target is realized as the onset [pʰ] in loanword adaptation due to the inserted vowel after the target. However, no studies have addressed the various patterns of /f/ depending on its prosodic position.

Thus, this paper extensively examines the different modifications of English /f/ in Korean loanword phonology within the framework of Optimality theory (McCarthy and Prince 1995). Specifically, we show that the markedness constraint of *Structure is the driving force for the modifications of /f/ in Korean. Yet, we get different realizations [pʰ] and [hw]/[hu] of the target /f/ in Korean due to the two different sources of borrowing: direct borrowing and indirect borrowing via Japanese. Further, the realization of [hu] when the target /f/ occurs in a consonant cluster is accounted for by the constraint of OCP (Obligatory Contour Principle). Also the fact that the coda /f/ in the source language is always rendered as [pʰ]-plus-vowel can be accounted for by the constraint of Release-to-vowel insertion, which incorporates the perceptual aspect of the source word.

The paper is structured as follows: Section 2 provides a brief review of the previous studies on loanword phonology, with a special emphasis on Korean loanwords. Section 3 presents data on the adaptations of English /f/ in Korean. Section 4 offers a constraint-based analysis of the loanword data, showing that the two different borrowing sources of the target sound /f/ lead to the various realizations of /f/ in Korean. Section 5 is the conclusion.

2. Previous studies on loanword phonology

2.1 Input to the loanword adaptation process

There has been a controversy regarding how borrowers perceive borrowed sounds in loanword adaptation. Scholars such as Silverman (1992) and Peperkamp and Dupoux (2003) contend that the borrowers' perception of foreign sounds is influenced by their native language grammar so that adaptation may occur during speech perception due to the failure of correct perception of the borrowed sounds. That is, the acoustic signal of the borrowed sounds is interpreted through the lens of the adapters' perceptual system, which is attuned exclusively to their native language as to cause perceptual deafness of foreign sounds. Consequently, the foreign sounds can be heard distorted and as a result, the input of the foreign sounds in the recipient language may be different from that in the source language.

By contrast, LaCharite and Paradis (2005) and Shinohara (2005) have an opposite view on the input of foreign sounds. In particular, LaCharite and Paradis maintain that the borrowers are bilinguals and thus, they are able to accurately perceive the foreign sounds without any interference from their native language. Accordingly, the input representation of the foreign sounds in the recipient language correctly refers to the mental representations and categories of the sounds in the source language. Along the same line, Shinohara assumes a full phonological representation of borrowed sounds since they are still audible to the adapters. However, Lacharite and Paradis and Shinohara differ from each other in the view of why loanword adaptation occurs. While the former employs a phonological perspective, the latter employs a phonetic perspective.[1] Both of the two different perspectives on whether adaptation is phonological or phonetic are discussed in detail in the following subsection.

2.2 Phonetic approach vs. phonological approach

There have been at least two different approaches to loanword phonology in general: A phonetics-based approach and a phonology-based approach. The phonetics-based approach has been developed by scholars such as Steriade (2001a, b), Kenstowicz (2001, 2003), Peperkamp and Dupoux(2003), and Shinohara (2005).[2] In this approach loanword

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[1] According to Shinohara, borrowed sounds are fully perceived, but adaptation occurs because of the drive to match the differences between the source language and recipient language based on low-level phonetic facts such as acoustic functions and auditory perceptibility.

[2] However, Peperkamp and Dupoux differ from other scholars in claiming that loanword adaptation is accomplished during speech perception, which is in an extra-grammatical module. According to Peperkamp and Dupoux, when the adapters produce the borrowed sounds with an inserted vowel, the inserted vowel would be present in the input of the adapters. This is because the native language of the adapters directly interferes with the

adaptation is seen as a problem of perceptually matching the words of the source language to those in the recipient language. Consequently, low-level subphonemic acoustic properties can play a role in determining the forms in borrowing. Specifically, words are borrowed into the recipient language with the sounds that are perceptually most similar to those in the source language.[3]

By contrast, in the phonological approach proposed by LaCharite and Paradis (2002, 2005) borrowing is inherently phonological, thus subphonemic variants play little role. According to them, loan adaptation is primarily done by bilinguals, who accurately identify the source sound categories, and thus bilingual borrowers prefer category (phonemic) proximity over perceptual (subphonemic) proximity and the low level acoustic differences are irrelevant in the borrowing process.

With respect to Korean loanword phonology, Kang (2003) argues for the phonetics-based approach in that subphonemic details of the sounds of the source and recipient languages are important in loan adaptation. For instance, English final stops are more likely to be released with a vowel in Korean loanwords when the vowel preceding the target stop is tense or long. Kang accounts for the high frequency of vowel insertion after tense or long vowels by the high frequency of release for final stops after tense vowels in English by conducting a survey of the English corpus. According to the survey, 145 stops were released out of 248 stops after tense vowels, whereas only 16 stops were released out of 402 stops after lax vowels. This shows that Korean adapters are also sensitive to the non-distinctive phonetic properties such as release and unrelease of the source language.

By contrast, Oh (1996) argues for the phonology-based approach. For instance, the English coronal stop /t/ in words like *tie* and *stick* is rendered as the aspirated stop [t^{h}aɪ] and [st^{h}ɪk] in Korean loanwords, although the tense stop [t'] should be the best fit for the unaspirated coronal stop in *stick* (cf. Kang 2003). This is because the tense series of Korean stops would match the English voiceless unaspirated stops perceptually better than the aspirated stops in Korean given that Korean aspirated stops are heavily aspirated with respect to voice onset time from the phonetic perspective. This shows that Korean adapters do seem to ignore non-distinctive phonetic properties of the source word such as aspiration in the borrowing process but to be aware that English unaspirated stops are allophones of the aspirated phonemes. Consequently, this case shows that adaptation of the

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phonetic perception of the borrowed sounds, resulting in misperception with an inserted vowel. By contrast, other scholars assume that the knowledge of phonetic perception is rather indirectly encoded as part of grammar, so that the borrowed sounds are evaluated by the grammar including universal perceptibility degrees based on acoustic properties of the sounds.
[3] Silverman (1992) also views that all loanword adaptation is phonetic approximation. For instance, when Cantonese speakers are confronted with an English segment that does not exist in Cantonese, they will represent and produce a segment which most closely approximates the input in articulatory and/or acoustic properties. This adaptation process occurs, although many Cantonese speakers possess a good command of both spoken and written English.

English sounds is based on English phonemes, not on English allophones.[4]

   Iverson and Lee's (2004) view on loan adaptation is midway between the phonetics-based approach and the phonology-based approach. They propose a principle of phonological perception, which maintains that phonetic representations from the source language are decoded in terms of the salient perceptual categories of the recipient language. For example, English /f/ is realized as the aspirated bilabial stop in Korean loan adaptation because [pʰ] closely approximates [f] with respect to the feature [spread glottis]. That is, [spread glottis] is phonemic in Korean and thus Korean speakers are sensitive to the aspiration contrast (e.g., *film* [pʰillɨm]). Similarly, English /v/ is rendered as the plain bilabial stop [p] in Korean loanwords as English [v] is not articulated with [spread glottis] and consequently [p] would best fit for the English /v/ (e.g., *victory* [pik˺tʰoɾi]). Thus, Iverson and Lee claim that not the phonetic property in the source language but the interpretation of those features depending on their phonological saliency in the recipient language is important in loan adaptation.

   Although some studies like Lee and Cho (2006) and Kang et al. (2008) notice the different adaptations of English /f/ in Korean loanwords, they do not provide a formal account of the English /f/ adaptation in terms of direct borrowing and indirect borrowing. In particular, Lee and Cho (2006) analyze the /f/ adaptation by conjoining two markedness constraints *[Labial] and *[Fricative]. The realization of /f/ as the bilabial aspirated stop [pʰ] in Korean is accounted for by high ranking of the conjoined markedness constraint and the constraint *[Fricative]. However, the replacement of the fricative /f/ with the stop [pʰ] leads to a violation of the faithfulness constraint Ident[continuant]. The realization of /f/ as the fricative [hw] in Korean occurs because the conjoined markedness constraint and Ident[continuant] are ranked high in their analysis.

   So far, we have examined some theoretical background and previous studies on loanword adaptations. Most studies on Korean loan adaptation fail to notice the various adaptations of English /f/ in word-initial position and further the asymmetrical behavior of /f/ depending on its prosodic position in the source language. Moreover, no study formally analyzes the different adaptations of /f/ in terms of direct borrowing and indirect borrowing. Thus, in this paper we extensively provide an account of the different adaptations of /f/ in various prosodic positions in Korean, employing an Optimality-theoretic approach.

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[4] However, Iverson (2005) provides an alternative explanation for this case which argues for the phonological approach. Instead of knowing that English voiceless unaspirated stops are allophones of the aspirated phonemes, Korean adapters are well aware of the fact that English spelling p, t, and k correspond to Korean aspirated stops irrespective of their degree of aspiration in English. Thus, Iverson contends that the adapter's awareness of the source language spelling conventions, not preservation of source language categories, plays a key role in shaping borrowed sounds into the recipient language.

3. Data

English /f/ can be realized in several different ways in Korean loanword adaptation. Specifically, Iverson and Lee (2004), and Oh (2002) mention that English /f/ is realized as the aspirated bilabial stop [pʰ]. However, /f/ can surface either as the aspirated bilabial stop or as the sequence of glottal fricative-plus-bilabial onglide [hw], as given in (1). Specifically, /f/ is exclusively realized as [pʰ] in words like *fax* and *phone*, as shown in (1a). However, /f/ emerges as [hw] in words like *fence* and *fiber*, as in (1b), and the realization of [pʰ] is also possible, even though it is less favorable. Further, the realization of /f/ as [hw] shows variation as given in (1c), depending on the quality of the following segments. When the target /f/ appears in a consonant cluster in the source language, it surfaces as [hu] in words like *fresh* and *fruits*. Notice that the realization of [pʰ] is also possible in these words. In addition, the onset target /f/ may have two outputs in some words, [pʰ] and [hw], as shown in (1d).

(1) English /f/ in word-initial onset position
   a. [pʰ] exclusively
      fax [pʰækˀsˀɨ]   phone [pʰon]
      France [pʰɨraŋsˀɨ]   photo [pʰotʰo]
   b. [hw] preferably
      fence [hwensˀɨ] [pʰensˀɨ]   fiber [hwaibə]/[hwaiba] [pʰaibə]
      fine [hwain] [pʰain]   finale [hwinalle] [pʰinalle]
      ferry [hweri] [pʰeri]   fish burger [hwiʃibəgə] [pʰiʃibəgə]
      foundation [hwaundeiʃən] [pʰaundeiʃən]
   c. [hu] preferably
      fresh [hureʃi] [pʰɨreʃi]   fruits [hurucʰɨ] [pʰɨricʰɨ]
      flavor [hurebə] [pʰɨllebə]   freedom [huridəm] [pʰɨridəm]
      fry [hurai] [pʰɨrai]   flash [huraʃi] [pʰɨlleʃi]
      French pie [hurencʰipʰai] [pʰɨrencʰipʰai]
   d. Two outputs [pʰ] and [hw]
      family [pʰæmilli] [hwæmilli]   fighting [pʰaitʰiŋ] [hwaitʰiŋ]
      file [pʰail] [hwail]   fantasy[pʰantʰaǰi] [hwanthaǰi]

The loanwords with [h] are considered as Japanese influence while the loanwords with exclusively [pʰ] are considered as recent borrowings.
   Likewise, /f/ in word-medial onset position is realized as [pʰ] and/or [h], as given in (2).

(2) English /f/ in word-medial onset position
   a. [pʰ]
      sofa [sˀopʰa]   caffeine [kʰapʰein]
      office [opʰisˀɨ]   graphic [kɨræpʰikˀ]

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  b. [h] and/or [pʰ]
    kungfu [kʰuŋhu]   wafer [wehas'ɨ]
    refresh [rihureʃi] [ripʰɨreʃi]   muffler [mahura] [məpʰɨllə]

Finally, /f/ in word-final coda position in the source language emerges as [pʰ]-plus-vowel, as given in (3). Korean does allow unreleased stops in the coda position, thus English /f/ could be realized as the unreleased bilabial stop [p̚] in the coda. However, English /f/ always surfaces as the sequence of aspirated bilabial stop-plus-inserted vowel, which shows that the coda target is realized as the onset in loanword adaptation.

(3) English /f/ in word-final coda position
    knife [naipʰɨ]   soft [sopʰitʰɨ]
    graph [kɨræpʰɨ]   wife [waipʰɨ]

According to Kang's (2003: 235) release-to-vowel insertion hypothesis, there is a correlation between stop release and vowel insertion in such a way that Korean stop-plus-inserted vowel [ɨ] sequences and the corresponding English release stop are acoustically very similar. This is not uncommon given the observation by Parker (1977) in which a released voiced stop in English is an acoustic syllable consisting of a stop plus a vocalic sound. The hypothesis of release-to-vowel insertion can be generalized to include cases like vowel insertion after fricatives. This is because fricatives are similar to aspirated stops in that fricatives are inherently released. Therefore, fricatives and aspirated stops share the property of air releaseness. Then, the fact that the English target /f/ in the coda is always realized as the aspirated bilabial stop-plus-inserted vowel sequences can be accounted for by the generalized release-to-vowel insertion hypothesis. Consequently, fricatives are realized in the onset position in Korean loanword phonology.

   Before we move on to the analysis of the presented data, we need to clarify the reason for why the target /f/ in Korean can have two different realizations: The aspirated bilabial stop [pʰ] and the sequence of glottal fricative-plus-onglide [hw]. The different adaptations of /f/ may result from the fact that /f/ has been borrowed in the Korean language via at least two different sources: The early borrowings via Japanese and the direct borrowings from English. Specifically, English /f/ is always rendered as the bilabial fricative [ɸ] in Japanese regardless of its position in the source language, as shown below.

(4) English /f/ in Japanese loanword adaptation
    a. Word-initial onset
      file [ɸairu]   family [ɸamiri]
    b. Word-medial onset
      sofa [soɸaː]   office [oɸisu]

    c. Word-final coda
        scarf [suka: ɸu]   laugh [laɸu]

The Japanese sound which is closest to English /f/ is the bilabial fricative [ɸ], an allophone of /h/.

   In Japanese phonology [ɸ] is an allophone of /h/ and it occurs only before the high back vowel [ɯ].[5] Nonetheless, [ɸ] is not restricted to occur only before the high back vowel, as shown in (4). Thus, Iverson (2004) observes that Japanese sometimes insert [u] in borrowings of words like *feminist* ([ɸueminisuto]) or *fight* ([ɸuaito]), in order to make the pronunciation of [ɸ] phonotactically possible. However, in more recent adaptations like [ɸeminisuto] and [ɸaito] it is a natural tendency to disregard non-distinctive, subphonemic features of a native language during loanword adaptation in order to approximate more closely the source language pronunciation. Vance (2003) also notices that it is only in recent borrowings that [ɸ] appears immediately before phonemes other than [ɯ]. This is because [ɸ] was in complementary distribution with [h] and [ç] until quite recently. Accordingly, Japanese has undergone a phonemic split, in which former allophones of a single phoneme have become contrastive because of some changes brought by phonological phenomena like loan adaptation in the language.

   The realization of the English /f/ as [ɸ] in Japanese, then, may provide some answer to the unexpected realizations of the target /f/ as [hw] or [hu] in Korean; English words, in which /f/ is realized as [hw] or [hu] in Korean, may have been derived via Japanese. This is because the Japanese language tremendously influenced the Korean language in the early 1900's during the colonial era. Most Koreans were bilinguals of Korean and Japanese at that time. Consequently, the borrowers who were fluent bilinguals were accurately able to perceive the Japanese sound [ɸ] and even to identify the contrastive category of [ɸ] in Japanese. That is, the Korean adapters were well aware of the fact that [ɸ] belongs to the category of /h/ in Japanese phonology and thus, they might replace [ɸ] with either [hw] or [hu] in order to preserve the category of the borrowed sound as well as to conform to the structure of the recipient language, Korean, in terms of place and manner. Then, this is a clear case of category preservation proposed by Lacharite and Paradis (2005: 226).

   To summarize, English /f/ in some early loanwords, indirectly via Japanese, is realized as either [hw] or [hu], while that in some other words borrowed directly from English is rendered as [pʰ]. Moreover, because some words were borrowed via Japanese and then secondarily from English again, they may have two variants, as given in (1d). However, because English plays a more dominant role as an international language in

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[5] According to Tsujimura (1996), /h/ becomes [ɸ] when it occurs before the high back vowel [ɯ] (e.g., [ɸɯkai] 'deep') whereas /h/ becomes [ç] when it occurs before [i] (e.g., [çito] 'person'). /h/ remains before [o, a, e] (e.g., [yoho:] 'forecast').

the world and because Koreans, especially the rising generation Koreans have increasingly been exposed to English, recent borrowings with /f/ seem more likely to be rendered as [pʰ] than as [hw]/[hu]. In the following section, we offer an optimality-theoretic analysis of the different adaptation patterns of English /f/.

4. Analysis

The English target /f/, whether it is borrowed directly from English or indirectly via Japanese /ɸ/, is not a legitimate sound in Korean. Thus, we adopt the constraint of *Structure which ensures that structure is constructed minimally so as to eliminate extra structure (Prince and Somolensky 1993). The consequence of the *Structure constraint is to eliminate foreign sounds that are not present in the Korean language inventory. This is a generalized inventory constraint, replacing the individual markedness constraints such as *f and *ɸ. The constraint of *Structure is undominated in Korean loanword phonology as well as in native phonology, which is the driving force for the adaptations of the English target /f/.

   The substitution of /f/ by [pʰ] leads to a violation of the relevant antagonistic faithfulness constraint Ident[continuant] because the target fricative /f/ becomes the stop [pʰ]. However, the realization of [pʰ] does not violate the faithfulness constraint Ident[labial] because the output still contains the labial feature. This shows that the constraint Ident[labial] crucially dominates the constraint Ident[continuant]. Namely, it is more important to preserve the labial feature from the source than to preserve the feature [continuant]. However, the ranking between *Structure and Ident[labial] is not decisive. Importantly, the target /f/ is not replaced with [hw], although [hw] preserves both the labial and continuant features of the source. This is because the realization of a single element in the input as multiple or double elements in the output is disfavored. The constraint of Integrity (McCarthy and Prince 1995) prohibits the multiple correspondents between the input and the output. Some relevant constraints and their rankings are presented below for the illustration of the word *fax* adaptation.

(5) The realization of /f/ in word-initial onset position: /f/ as [pʰ] in *fax*
        a. Constraints:
            *Structure: Eliminate extra structures that are not in the inventory.
            Ident[labial]: Correspondent segments in the input and output
                    have identical values for the place feature [labial].
            Integrity: No element in the input has multiple correspondents in
                    the output.
            Ident[contiuant]: Correspondent segments in the input and output
                    have identical values for the feature [continuant].

b. Constraint rankings:
   *Structure, Ident[labial]>>Integrity>>Ident[continuant]

c. Tableau[6]

/f/	*Struct	Ident[lab]	Integrity	Ident[cont]
a. [f]	*!			
b. [ɸ]	*!			
☞ c. [pʰ]				*
d.[hw]			*!	
e. [h]		*!		
f. [sw]			*!	
g. [s]		*!		

In (5) candidates (a) and (b) fatally violate *Structure because [f] and [ɸ] are not in the inventory of Korean, thus being eliminated. Candidates (e) and (g) incur a crucial violation of the constraint Ident[labial]. Candidates (d) and (f) fatally violate the constraint Integrity. Thus, candidate (c) surfaces as the optimal output, even though it violates Ident[continuant], as it is low-ranked and thus it does not play a decisive role in the selection of the optimal form.

   Loanwords realized as [hw] or [hu] instead of [pʰ] might not be borrowed directly from English but might be derived through Japanese in early borrowings. If English were the source, the adaptation of /f/ as [hw] would be odd since the closest Korean phonetic and phonemic approximation to the English target /f/ should be [pʰ], which is the closest obstruent to the target. On the other hand, assuming that Japanese is the source, the realization of [hw] or [hu] from the Japanese source /ɸ/ is well-motivated from the perspective of phonemic approximation. Loanword adaptation in early borrowings in Korean would be based on the perception by very proficient bilingual adapters of Korean and Japanese. This implies that the bilinguals were able to perceive the accurate phonemic category of [ɸ], which closely conforms to the glottal fricative /h/ in Korean. Then, there is the matching category /h/ in Korean for the Japanese target /ɸ/. Thus, the replacement of /ɸ/ with the /h/ category results from the principle of Category preservation/proximity in Lacharite and Paradis (2005).

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[6] In addition, the target /f/ and the winner [pʰ] share the property of "release", in that fricatives are inherently released and aspiration also involves the release of air. Thus, it is [pʰ] that most closely approximates the target /f/ in terms of the feature release. In contrast, the release feature is not so prominent for the plain bilabial stop [p] and the constricted bilabial stop [p']. Therefore, they are not considered as candidates. Ahn (2003) also observes that neither the plain [p] nor the tense [p'] substitutes the English voiceless /f/. According to him, the plain one does not enhance the feature [stiff vocal folds] which is a characteristic of voiceless /f/, and the tense one involves double timing slots unlike /f/.

(6) Category preservation: Preserve the phonemic category of L2 sounds in L1 as closely as possible.

Because of the Category preservation constraint, Japanese /ɸ/ is adapted as the phonologically closest Korean /h/ category. The realization of [hw]/[hu] from /ɸ/ would be unexpected from the perspective of phonetic approximation given that the obstruction of air in the mouth and the inherent release of air match best to Korean [pʰ]. The constraint of Category preservation is ranked higher than the constraint Ident [continuant] so as to eliminate a possible candidate [pʰ], but is ranked lower than the constraint Ident[labial] to eliminate [h]. The following shows the realization of [hw] in indirect borrowings from Japanese /ɸ/.

(7) The realization of /ɸ/ in word-initial onset position: /ɸ/ as [hw] in *fiber*
    a. Constraint rankings:*Structure, Ident[labial]>>Integrity,
       Category preservation >> Ident[continuant]
    b. Tableau

/ɸ/	*Struct	Ident[lab]	Integrity	Category preservatio	Ident[cont]
a. [f]	*!			*	
b. [ɸ]	*!			*	
c. [pʰ]				*	*!
☞ d.[hw]			*		
e. [h]		*!			
f. [sw]			*	*!	
g. [s]		*!		*	

Candidates (a) and (b) are out due to a fatal violation of the constraint *Structure. In addition, candidates (a) and (b) violate the constraint Category preservation because [f] and [ɸ] do not correspond to any category in Korean. The matching category in Korean for the Japanese source /ɸ/ is /h/. Candidate (e) crucially violates Ident[labial] as [h] does not have any constriction in the supralaryngeal tract. Likewise, candidate (g) fatally violates Ident[labial] as well as the constraint Category preservation. While candidate (f) incurs a fatal violation of the constraint Category preservation, candidate (d) does not. Thus, the competition passes down to candidates (c) and (d). Candidate (c) violates Category preservation because [pʰ] is not a close category to the Japanese source /ɸ/. In addition, it also violates the constraint Ident[continuant], as the target fricative is realized as a stop sound. In contrast, candidate (d) does not violate Category preservation since it belongs to the category /h/. Consequently, it wins out although it violates the constraint of Integrity.

The English target /f/ via Japanese is also realized as the sequence of glottal fricative-plus-rounded vowel [hu], when the following segment is a consonant, as in *fruits* [huruc^{h}ɨ] and *flavor* [hurebə]. The target /ɸ/ is not realized as [hw] but is realized as [hu] because a default vowel [ɨ] is inserted between the consonants in a cluster such as [hwr] and [hwl] and the vowel becomes [u] because [w] triggers rounding assimilation. Then, [hwu] becomes [hu] since [w] and [u] violate the OCP constraint, which prevents the sequence of the feature [+round][7]. The OCP should outrank the antagonistic faithfulness constraint Dep[V], which militates against the insertion of a vowel. The following illustrates the realization of /ɸ/ before a consonant.

(8) The realization of /ɸ/ in word-initial onset position: /ɸ/ as [hu] in *fresh*
    a. Constraint rankings:
        *Structure, Ident[labial]>>Integrity, Category preservation>>
        OCP, Ident[continuant]>> Dep[V]
    b. Tableau[8]

/ɸ/	*Struct	Ident [lab]	Inte-grity	Category preserv	Ident [cont]	OCP	Dep[V]
a. [f]	*!			*			*
b. [ɸ]	*!			*			*
c. [p^h]				*	*!		*
d. [hwu]			*			*!	*
e. [h]		*!					*
f. [swu]			*	*!		*	*
g. [s]		*!		*			*
☞ h. [hu]			*				*

In (8) candidate (d) incurs a crucial violation of the constraint OCP as [hw] is followed by the rounded vowel [u]. On the other hand, candidate (h) violates the constraint Integrity because the input /ɸ/ is realized as multiple correspondents [hu]. However, it does not violate OCP because [wu] is simplified as [u]. As a result, candidate (h) becomes the winner.

Now, let us consider the variation case. The target /f/ is frequently realized as [p^h], but it is sometimes rendered as [hw], as given in (1d) (e.g.,

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[7] Notice that this process involves the violation of the constraint Dep.
[8] When the Japanese source /ɸ/ is followed by a consonant, the vowel [ɨ] is inserted between the consonant sequence. This means that there is the inserted vowel [ɨ] in candidates (a), (b), (c), (e) and (g). However, we do not include the vowel in the tableau for the sake of convenience. Additionally, words like *fruits* and *flavor* can be realized as [p^{h}iruc^{h}ɨ] and [p^{h}illebə], respectively. In this case the source for [p^h] comes directly from English /f/. As mentioned above, there can be two different underlying forms /ɸ/ and /f/ for words with two variants.

file [pʰail], [hwail]). The dual adaptation patterns are due to the two different sources: directly from the English source /f/ and indirectly via the Japanese source /ɸ/. The following tableaux show how the two different sources result in the two different adaptation patterns.

(9)　The dual realizations of /f/ in word-initial onset position
　　a.　Directly from English: /f/ as [pʰ] in *file*

/f/	*Struct	Ident [lab]	Integrity	Category preserv	Ident [cont]	OCP	Dep[V]
a. [f]	*!						
b. [ɸ]	*!						
☞ c. [pʰ]					*		
d.[hw]			*!				
e. [h]		*!					
f. [sw]			*!				
g. [s]		*!					

　　　　b. Indirectly via Japanese: /ɸ/ as [hw] in *file*

/ɸ/	*Struct	Ident [lab]	Inte-grity	Category preserv	Ident [cont]	OCP	Dep[V]
a. [f]	*!			*			
b. [ɸ]	*!			*			
c. [pʰ]				*	*!		
☞ d.[hw]			*				
e. [h]		*!					
f. [sw]			*	*!			
g. [s]		*!		*			

In (9a) the constraint Category preservation is not relevant because there is no matching category for the English source /f/ in Korean, unlike the case of the Japanese source, where the matching category for the Japanese [ɸ] is /h/ in Korean. In other words, there is no sound which closely approximates the English source /f/ in terms of category. Also, the constraint OCP and Dep[V] are not relevant here since there is no following consonant after the target. Candidates (a) and (b) are out because of a fatal violation of the constraint *Structure. Candidates (d) and (f) are eliminated since they incur a fatal violation of Integrity. Candidates (e) and (g) crucially violate Ident[labial] and thus, are out of consideration. Therefore, candidate (c) becomes the winner. In contrast, in (9b) the constraint Category preservation is effective because there is the matching

category /h/ in Korean for Japanese [ɸ]. Candidate (c) which is the winner when the source is English /f/ is eliminated because of Category preservation. Thus, candidate (d) wins out because it only violates Integrity. This shows that it is the two different sources that cause the two optional outputs of /f/ realization. The constraint ranking remains the same.

As for word-medial onset position, the target /f/ is realized as [pʰ] and/or [hu], as shown in the following tableau.

(10) The realization of /f/ in word-medial onset position
  a. Directly from English: /f/ as [pʰ] in *muffler*

/f/	*Struct	Ident [lab]	Inte-grity	Category preserv	Ident [cont]	OCP	Dep[V]
a. [f]	*!						*
b. [ɸ]	*!						*
☞ c. [pʰ]					*		*
d. [hwu]			*!			*	*
e. [h]		*!					*
f. [swu]			*!			*	*
g. [s]		*!					*
h. [hu]			*!				*

  b. Indirectly from Japanese source: /ɸ/as [hu] in *muffler*[9]

/ɸ/	*Struct	Ident [lab]	Inte-grity	Category preserv	Ident [cont]	OCP	Dep[V]
a. [f]	*!			*			*
b. [ɸ]	*!			*			*
c. [pʰ]				*	*!		*
d. [hwu]			*			*!	*
e. [h]		*!					*
f. [swu]			*	*!		*	*
g. [s]		*!		*			*
☞ h. [hu]			*				*

In (10a) the constraint Category preservation is not relevant because there is no matching category for the source /f/. Candidates (d), (f) and (h)

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[9] In the case of the word *wafers* [wehasɨ] the source /ɸ/ is not realized as [hu] but as [h]. Candidate with [h] would violate the constraint Ident[labial]. However, the violation of Ident[labial] can be exempted if we assume that the labial feature is linked to that of the initial onglide /w/ due to OCP.

crucially violate the constraint Integrity, and thus they are out of consideration. Candidates (e) and (g) incur a fatal violation of Ident[labial]. Accordingly, candidate (c) emerges as the optimal form, in spite of its violation of Ident[continuant] and Dep[V]. In contrast, in (10b) the constraint Category preservation is relevant because there is the matching category /h/ for the source /ɸ/. All candidates except candidates (d), (e), and (h) violate the constraint Category preservation. Candidate (e) fatally violates Ident[labial], thus being eliminated. Candidate (d) is out of consideration due to the violation of OCP (Leben 1973). Consequently, candidate (h) turns out to be the optimal output.

The realization of /f/ as [p^h] in word-final coda position can be accounted for in the similar way as the onset position case. However, we need another constraint in order to distinguish a released candidate through vowel insertion from an unreleased candidate. As mentioned above, the target /f/ is realized as the aspirated bilabial stop-plus-inserted vowel sequences because fricative consonants and aspirated stops share the property of air releaseness. This can be accounted for by the generalized release-to-vowel insertion hypothesis. Thus, we extend the release-to-vowel insertion hypothesis proposed by Kang (2003) to make it apply to fricatives as well as to stops, as given below.

(11) Release-to-vowel insertion
        Segments or features in the correspondence relationship should be
         similar with respect to release.

The Release-to-vowel insertion constraint should outrank Dep(V). This is because fricatives are inherently released so that it is more important to correlate fricative release with vowel insertion at the expense of the violation of Dep(V), which penalizes the insertion of a vowel. Consequently, the more Korean native-faithful pronunciation [p$^˺$], which is unreleased in the coda, does not surface, as it is dissimilar to the source /f/ in terms of release.

With this constraint and constraint ranking, let us consider the realization of /f/ in the coda position.

(12) The realization of /f/ in word-final coda position: /f/ as [pʰɨ] in *knife* [naipʰɨ][10]

/f/	*Struct	Ident [lab]	Inte-grity	Category preserv	Ident [cont]	OCP	Rel	Dep (V)
a. [f]	*!							
b. [ɸ]	*!							
☞ c.[pʰɨ]					*			*
d. [p˺]					*		*!	
e. [hw]			*!					
f. [h]		*!						
g. [sw]			*!					
h. [s]		*!						

As given in (12), candidates (a) and (b) cannot be the optimal output, as they fatally violate *Structure. Candidates (e) and (g) also incur a fatal violation of Integrity. Candidates (f) and (h) are eliminated because of a fatal violation of Ident[labial]. Then, the competition goes down between candidates (c) and (d). They both violate Ident[continuant]. However, candidate (d) violates the constraint Release. Accordingly, candidate (c) becomes the winner, even though it violates the constraint Dep(V).

The ranking for the realization of /f/ is summarized in (13).

(13) Constraint ranking for the English /f/ adaptation
    *Structure, Ident[labial]>> Integrity, Category preservation>>
    Ident[cont], OCP, Release-to-vowel insertion>> Dep(V)

The ranking accounts for the realization of the English target /f/ adaptation: The two different realizations depending on the two different sources, the variation case, and different realizations depending on its prosodic position like onset and coda in the source language. This shows that the target /f/ is realized based on the same ranking. We do not need to posit different rankings for each case or for each different lexical word.

5. Conclusion

In this paper, various adaptation patterns of English /f/ in Korean loanword phonology have been accounted for within Optimality Theory. In Korean, the target /f/ is realized as the aspirated bilabial stop [pʰ] or as the sequence of glottal fricative [hw]/[hu] because of the two different sources: One directly from the English target /f/ and the other indirectly via the Japanese

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[10] The sequence of [hwɨ] is not considered as a possible candidate in this tableau because Korean phonotactics prohibits [wɨ] or [wu].

sound /ɸ/. The realization of [hw]/[hu] in indirect borrowing via Japanese is accounted for by the constraint of Category preservation whereby the matching category for the Japanese source /ɸ/ is Korean /h/. In contrast, there is no matching category for the English source /f/, thus Category preservation becomes irrelevant in direct borrowing from English. The realization of $[p^h]$ occurs more frequently than that of [hw], especially in more recent loanwords, since there are more English loanwords borrowed directly from English. Importantly, the two different realizations, $[p^h]$ and [hw]/[hu] for the target /f/ have been accounted for by the same constraint ranking given in (13). Further, it has been shown that there are loanwords with two outputs because the loanwords were first borrowed indirectly through Japanese and later adapted secondarily from English, thus having two different sources. It has also been shown that /f/ is realized as [hu] in word-initial and word-medial onset position when the target appears in a consonant cluster in the source language, due to the constraint OCP. In addition, the realization of /f/ as the aspirated bilabial stop-plus-inserted vowel sequences in word-final coda position has been accounted for by the generalized Release-to-vowel insertion constraint, which maximizes the perceptual similarity between the source and borrowing sounds.

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