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RESEARCH

Young vs. old Koreans' vowel insertion after word-final English and French postvocalic plosives: A case of contact-induced borrowing change

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This paper explores whether young vs. old Koreans' vowel insertion after word-final English and French postvocalic plosives has changed or not. For this purpose, we conducted a perception experiment wherein 40 Koreans who were born before 1960 and another 40 Koreans who were born after 1989 were recruited with 20 male and 20 female subjects in each group. The results show that the release of plosives and the voicing of unreleased plosives are key variables for vowel insertion in both age groups. In addition, our young Koreans have no significant difference in vowel insertion after word-final English and French plosives, regardless of whether the plosives are released or unreleased, regardless of whether they are voiceless or voiced and regardless of whether they are preceded by the tense vowel [aɪ], as in English stimuli, or by the non-tense vowel [a], as in the French stimuli. On the other hand, our old Koreans have differences in vowel insertion after the non-native plosives in the examined contexts, depending on whether the plosives are English or French.

Based on the results, we propose that vowel insertion in accordance with the plosive release and the voicing of unreleased plosives in the two groups is accounted for by Korean syllable structure with generational differences made by how two effects – the plosive voicing effect and the vowel-tenseness effect – are involved. We also propose that no significant difference in vowel insertion after word-final English and French plosives in the young group is a case of contact-induced borrowing change resulting from the English/French contact differences over time in Korean society.

Keywords: young vs. old Koreans; vowel insertion; word-final English and French plosives; language contact differences; contact-induced borrowing change

1 Introduction

English and French have the phonemic voicing contrast in plosives (e.g. Ladefoged 1999; 2001 for English; Dell 1973; 1995; Tranel 1987 for French), as shown in (1a). Korean has no phonemic voicing contrast. Instead, Korean has the three-way phonation contrast in plosives, that is, lenis, aspirated and fortis (e.g. Kim et al. 2005; 2010; 2015; 2018), as in (1b). While the voicing contrast in English and French is also made in coda position, the laryngeal contrast in Korean plosives is neutralized into their lenis counterparts by virtue of Coda Neutralization (e.g. Kim-Renaud 1974; Kim & Jongman 1996; H. Kim 1998), as in /ip^{h}/ → [ip] 'leaf'; /nat^{h}/ → [nat] 'each'; /nats^{h}/ → [nat] 'face'; /pak'/ → [pak] 'outside'; /pu.ʌk^{h}/ → [pu.ʌk] 'kitchen'.

(1) English and French (a) and Korean (b) plosives[1]

		labial	coronal	dorsal
a.	voiced	b	d	g
	voiceless	p	t	k
b.	lenis	p	t	k
	aspirated	p^h	t^h	k^h
	fortis	p'	t'	k'

With the differences between English/French and Korean plosives, variation in vowel insertion – vowel epenthesis, no vowel epenthesis and variable insertion (either vowel epenthesis or no vowel epenthesis) – is observed in Korean adaptation of word-final English and French postvocalic plosives from the survey of the 2011 data given in H. Kim (2014).[2,3] The word-final English postvocalic plosives [b, d, g, p, t, k] are borrowed as the Korean plosives /p, t, k, p^h, t^h, k^h/, respectively, when the vowel /ɨ/ is inserted, as in (2 i). When no vowel is inserted, the English voiceless plosives [p, k] which are borrowed as the aspirated /p^h, k^h/, undergo Coda Neutralization, resulting in the lenis /p, k/ in coda position, as in (2 b ii).[4] Then, the neutralized plosives /p, k/ surface as [p, k]. With no vowel insertion, the aspirated /t^h/ and /t/ for the English [t] and [d], respectively, are stored as the lenis fricative /s/ in lexicon, as in /hus/ 'Hood' and /tas/ 'dot', as in (2 ii). This is because Korean has the lexical restriction that the lenis fricative /s/, not coronal plosives such as /t, t^h, t'/ is allowed in coda position not only in native Korean words but also in loans (e.g. Kang et al. 2004; H. Kim 2014; 2017b).[5] For example, the fricative /s/ surfaces as [t] in coda position by virtue of Coda Neutralization and appears as [s] when a vowel-initial suffix such as a nominative marker /i/ is added in native words (e.g. /os/ → [ot] 'cloth'; /os + i/ → [o.sʲi] 'cloth' + Nom.) and in loans (e.g. /a.i.p^{h}as/ → [a.i.p^{h}at] 'iPod'; /a.i.p^{h}as + i/ → [a.i.p^{h}a.sʲi] 'iPod' + Nom.).[6,7] Some word-final English postvocalic

[1] The Korean fortis consonants as well as the other obstruents are produced on a pulmonic egressive airstream. Throughout the paper, they are transcribed with an apostrophe, following Kim et al. (2005; 2010; 2011; 2015; 2018) among others, as a deviation from the IPA value of the apostrophe which is used for an ejective. This is because there is no satisfactory IPA notation for Korean fortis consonants.

[2] Korean adapted forms in the present study are transcribed as lexical representations. In the text of the present paper, the notation '//' is used for lexical representations, and in the list of loanwords the notation is not used, as in (2) and (3), for the simplicity of data presentation. This transcription makes it easy for readers to see how the English/French voicing contrasts are borrowed into Korean. If we transcribed surface representations instead of lexical ones, the Korean adaptation of the voicing contrasts would be less straightforward because Korean lenis stops are usually voiced in intervocalic position on the surface (e.g. Silva 1992; Jun 1993; 1994; Kim et al. 2018). Throughout the text, the dot as in /ka.i.tɨ/ 'guide' and /pa.lo.k^h(k')ɨ/ 'baroque' refers to syllable boundary. In addition, throughout the text, Korean affricates are transcribed as alveolar in line with H. Kim (1997; 1999; 2001a; b; 2004; 2012) as well as Skaličková (1960).

[3] In the 2011 data survey, H. Kim (2014) referred to NIKL (The National Institute of the Korean Language) (2011), one loanword dictionary and thirteen books on American and French culture which have recently been published in Korea, to a Google online survey and to daily expressions used frequently in mass media.

[4] See H. Kim (2014) for further details.

[5] According to Kang et al. (2004), out of a total number of 426 nouns that end in [t] when pronounced in isolation, 308 of them end in a lexical /s/, no nouns end in lexical /t'/, 2 nouns end in /t/, and 116 nouns end in /t^h/ when coronal-final loans and non-standard dialectal forms are excluded from the Sejong corpus with 5.5 million words. In addition, according to the corpus-based survey of H. Kim (2017b), the word-final English postvocalic plosive *t* is borrowed as /s/ with no vowel insertion in Korean adaptation (i.e. 294 among 814 English words ending in the plosive in the early 1990s data and 291 among 517 in the 2011 data). This is also true of Korean adaptation of the word-final English postvocalic *d* as /s/ with no vowel insertion though the frequency of no vowel insertion is much lower.

[6] We are confined to the [t] ~ [s] alternation for the fricative /s/ because its detailed phonetic variation is not relevant to the present study. For its phonetic variation in native words and loanwords, see Jun & Lee (2007) among others in which 10 native speakers of North Kyungsang Korean participated in their experiments in order to examine how word-final coronal consonants including /s/ are realized when followed by vowel-initial suffixes (i.e. the nominative marker /i/, the objective marker /il/ and the locative marker /ɛ/). In their study, the fricative /s/ in the Korean word /os/ 'cloth' and in Korean adaptation of the word-final English postvocalic [t, d] in 'good, David, cut, Pat, Matt, meet' is most likely to surface as [s] when followed by the marker /i/.

[7] When Korean consonants come before the vowel /i/, the tongue moves gradually toward the hard palate as coarticulation (e.g. H. Kim 2012). This coarticulatory effect of Korean palatalization is transcribed as [Cʲ], for example, as in [o.sʲi] 'cloth' + Nom.

plosives are borrowed with variable insertion, as in the words *web*, *Hood*, *tag*, *soup*, *set* and *cake*.

(2) Korean adaptation of word-final English postvocalic (a) voiced [b, d, g] and (b) voiceless [p, t, k] plosives in the 2011 data

a. Voiced plosives	i. Epenthesis		ii. No epenthesis
globe	kɨl.lo.**pɨ**		
pub			p^{h}ʌ**p**
web	wɛ.**pɨ**	~	wɛ**p**
guide	ka.i.**tɨ**		
iPod			a.i.p^{h}a**s**
(Robin) Hood	hu.**tɨ**	~	hu**s**
league	li.**kɨ**		
handbag			hæn.tɨ.pæ**k**
tag	t^{h}æ.**kɨ**	~	t^{h}æ**k**

b. Voiceless plosives	i. Epenthesis		ii. No epenthesis
pipe	p^{h}a.i.**p^{h}ɨ**		
zip			tsi**p**
soup	su.**p^{h}ɨ**	~	su**p**
date	tɛ.i.**t^{h}ɨ**		
dot			ta**s**
set	s'ɛ(s).**t^{h}ɨ**	~	s'ɛ**s**
knock	no.**k^{h}ɨ**		
kick			k^{h}i**k**
cake	k^{h}ɛ.i.**k^{h}ɨ**	~	k^{h}ɛ.i**k**

Variation in vowel insertion also occurs after word-final French postvocalic plosives, as in (3). With the /ɨ/ vowel insertion, the word-final French voiced plosives [b, d, g] are borrowed as the lenis /p, t, k/, respectively, and the voiceless plosives [p, t, k] as either aspirated or fortis (/p^{h}/ or /p'/, /t^{h}/ or /t'/, /k^{h}/ or /k'/), as in /aŋ.k^{h}ɛ.t'(t^{h})ɨ/ 'enquete' and /pa.lo.k^{h}(k')ɨ/ 'baroque'. When no vowel is inserted, the French voiceless plosives [p, k] which are borrowed as either aspirated or fortis undergo Coda Neutralization, resulting in the lenis /p, k/ in coda position, as in (3b ii). As in the Korean adaptation of the English [t, d] with no vowel insertion, the French plosive [t] is stored as the lenis fricative /s/ in lexicon, as in /k^{h}ɨ.lo.k^{h}ɛs/ 'croquette'.[8] Variation insertion also occurs, as in the French words *Philippe*, *Antoinette* and *Balzac*.

(3) Korean adaptation of word-final French postvocalic (a) voiced [b, d, g] and (b) voiceless [p, t, k] plosives in the 2011 data

a. Voiced plosives	i. Epenthesis	ii. No epenthesis
(Rue) Jacob	tsa.k^{h}o.**pɨ**	
velib		pɛl.li**p**
Invalides	æŋ.pal.li.**tɨ**	
Claude (Monet)	k'ɨl.lo.**tɨ**	
langue	laŋ.**kɨ**	

[8] In the 2011 data (H. Kim 2014), no French loans ending in /d/ and /g/ are borrowed with no vowel insertion.

b.	Voiceless plosives	i. Epenthesis		ii. No epenthesis
	crepe	k^{h}ɨ.lɛ(or ɛ.i).**p^{h}ɨ**		
	Philippe	p^{h}il.li.**p^{h}ɨ**	~	p^{h}il.li**p**
	enquete	aŋ.**k^{h}ɛ.t'(t^{h})ɨ**		
	croquette			k^{h}ɨ.lo.k^{h}ɛ**s**
	(Marie) Antoinette	aŋ.t'ɨ.wa.nɛ.**t^{h}(t')ɨ**	~	aŋ.t'ɨ.wa.nɛ**s**
	baroque	pa.lo.**k^{h}(k')ɨ**		
	cognac			k'o.nja**k**
	Balzac	pal.tsa.**k^{h}ɨ**	~	pal.tsa**k**

In a recent survey of variation in vowel insertion after word-final English and French postvocalic plosives in the 2011 data in comparison to the early 1990s data, H. Kim (2015; 2017b) has found that the overall frequency of final vowel insertion is significantly decreased, whereas that of no vowel insertion is significantly increased in the 2011 data, no matter whether the plosives are English or French.[9] Especially, the significant decrease in vowel insertion and increase in no vowel insertion after word-final French plosives in the 2011 data is noteworthy, because vowel insertion is expected after them in Korean adaptation (e.g. H. Kang 1996; Y. Kang 2003) in that French plosives are usually released with the schwa [ᵊ] in word-final position (Tranel 1987: 133) (e.g. *cape* [kapᵊ] 'cape', *bath* [batᵊ] 'good', *sac* [sakᵊ] 'bag', *crabe* [krabᵊ] 'crab', *Sade* [sadᵊ] (surname), *bague* [bagᵊ] 'ring').[10] In addition, it has been reported in the literature that vowel insertion is more likely (a) when an English pre-final vowel is tense than when it is lax (the vowel-tenseness effect); (b) when an English final plosive is voiced than when it is voiceless (the plosive voicing effect); and (c) when an English final plosive is coronal and least likely when the final plosive is labial or dorsal (the plosive place of articulation effect) (e.g. Hirano 1994; Nam & Southard 1994; Broselow & Park 1995; Rhee & Choi 2001; Kang 2003; H. Kim 2014). However, H. Kim's (2015; 2017b) survey has revealed that the three effects have weakened in the 2011 data, compared to the early 1990s English data.

Given the corpus-based survey of H. Kim (2015; 2017b), we raise two questions in the present study. One is whether there would be any differences in the way that young and old Korean speakers insert a vowel after word-final English and French postvocalic plosives, depending on the release, the voicing and the place of articulation of the plosives. The other question is how the differences in vowel insertion between young and old Koreans, if any, could be explained. In order to investigate these questions, we conducted a perception experiment on young and old Koreans' vowel insertion after word-final English and French postvocalic plosives.

The structure of this study is as follows. In sections 2 and 3, the methods and results of our perception experiment are given, respectively; in section 4 a discussion of the results is presented; in section 5 theoretical implications are discussed; and in section 6 a brief conclusion is made.

2 Methods

As for English test words with word-final postvocalic plosives, six monosyllable-words beginning with the liquid /l/ were selected with the tense vowel /aɪ/ followed by the voice-

[9] The early 1990s English and French loanword data were collected from the books published by the National Academy of the Korean Language (NAKL 1991; 1995) which are a complete collection of loanword data from all the textbooks, dictionaries and daily newspapers in the early 1990s and also from books on French literature and culture published in 1990. Note that the National Academy of the Korean Language (NAKL) has recently changed into The National Institute of the Korean Language (NIKL).

[10] French has the voiced uvular fricative or approximant /ʁ/ (e.g. Tranel 1987: 27), but Tranel has transcribed it as /r/ throughout the text, as in *crabe* [krabᵊ] and *acteur* [akᵊtœr]. In the present study, we stick to the author's transcription.

less and voiced plosives /p, t, k, b, d, g/, as in (4a). French monosyllable-words beginning with the liquid /l/ were selected with the vowel /a/ followed by the plosives, as in (4b).[11]

(4) English (a) and French (b) test words

a.	layp, (/laɪp/)	layt, (/laɪt/)	layk (/laɪk/)
	layb, (/laɪb/)	layd, (/laɪd/)	layg (/laɪg/)
b.	lap, (/lap/)	lat, (/lat/)	lak (/lak/)
	lab, (/lab/)	lad, (/lad/)	lag (/lag/)

The English and French test words in (4) were randomly put together with six fillers (i.e. *papa*, *tata*, *kaka*, *baba*, *dada*, *gaga* with the vowel /a/) in a frame sentence 'I said _____' and 'il a dit _____' (*He said* _____ in French), respectively. Two male native speakers – one of American English and the other of Paris French in their early 30s – recorded the test words and fillers five times at a normal speech rate with no pause in the frame sentence at the soundproof recording room in the Laboratory of Phonetics and Phonology, CNRS/Sorbonne Nouvelle (University of Paris 3). The recording was made at a sampling rate of 44.1 kHz and at a quantization of 16 bit using an Audio-technical AT8033 microphone. The recorded data were then resampled at 22.05 kHz.

The third repetitions of the five-time recorded test words and fillers were selected, and then they were cut from the frame sentence for the present experiment. Since the native speakers pronounced all the test words in (4) with release, we prepared tokens with both release and no release by removing it. For example, as shown in the waveforms and wideband spectrograms of the English and French test words *layp* (/laɪp/) and *lab* (/lab/) in Figure 1 (a) and (b), respectively, a released voiceless plosive has a release burst, and a released voiced plosive has a schwa-like release, no matter whether it is English or French. For the unreleased plosives [p] and [b] in the English and French test words, respectively, the release burst duration after the oral closure of the English voiceless plosive and the vowel-like release duration after that of the French voiced plosive were excised.

The average values of some acoustic properties of released English and French plosives in the test words in (4) – closure duration, voicing duration, duration of a preceding vowel and release duration after voiceless and voiced plosives – are presented in Table 1. The average duration of a preceding vowel is longer in English plosives than in French ones, regardless of whether they are voiced or voiceless, because the vowel preceding English plosives is the tense, that is, diphthong /aɪ/, whereas the French vowel is the monophthong /a/ in the test words in (4). In addition, the average duration of oral closure and that of closure voicing are somewhat longer in English voiced plosives than in French counterparts.

40 Koreans who were born before 1960 and another 40 Koreans who were born after 1989 were recruited with 20 male and 20 female subjects in each group. The average age of the old group was 59.6 years old and that of the young group 21.9 years old at the time our experiment was conducted in Seoul, Korea. None of them had had any hearing impairments. A self-report language background form for English and French was completed by each subject. The average language background in the young group is 13.1 years for English and 0.034 year for French with none of them having learned French except for two female subjects' two-month learning. In the case of the old group, the average language background

[11] Different from English, French has no phonemic difference between tense and lax vowels (e.g. Dell 1973; 1995; Tranel 1987).

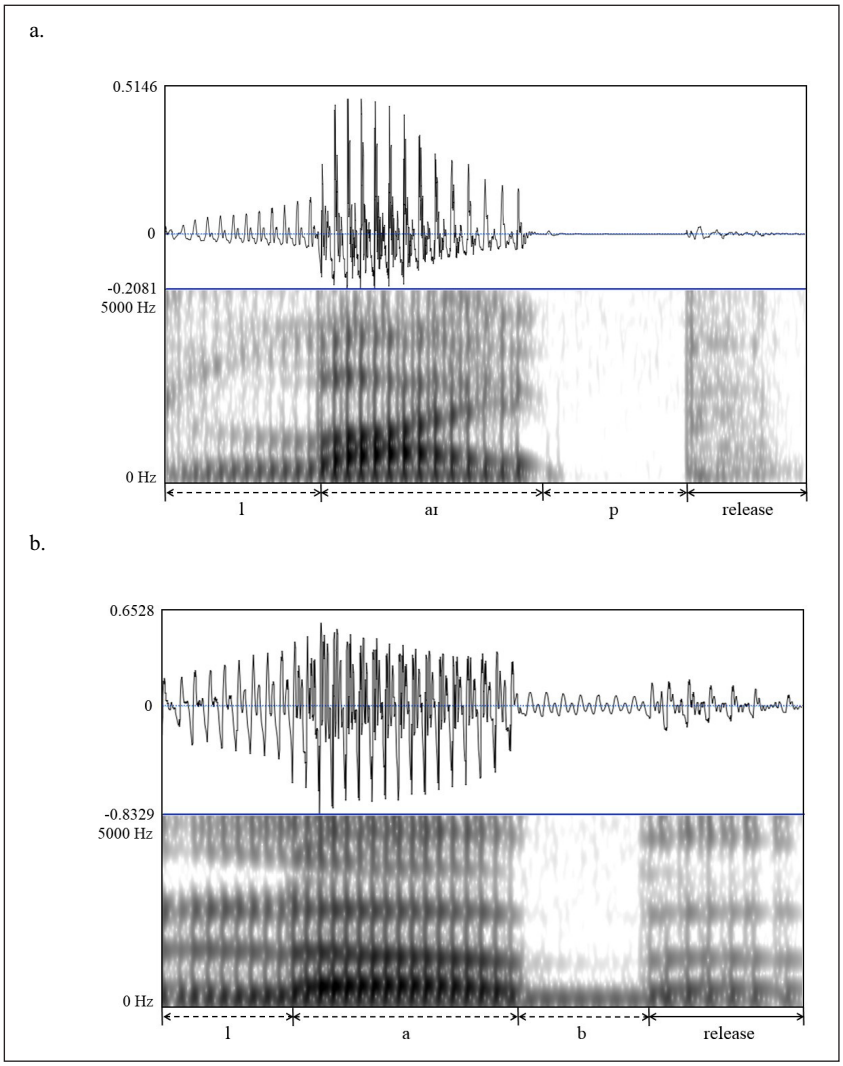


Figure 1: The waveform and wide-band spectrogram of the released **(a)** English [p] in *layp* [laɪp] and **(b)** French [b] in *lab* [lab].

Table 1: The average values of closure duration, voicing duration, duration of a preceding vowel and release duration of released English and French plosives in the test words in (4). The unit of each acoustic property is ms.

a.		
	English voiceless plosives	**French voiceless plosives**
oral closure duration	100.9	106.6
closure voicing duration	0	0
preceding vowel duration	153.1	108
release duration	129.9	125.1
b.		
	English voiced plosives	**French voiced plosives**
oral closure duration	81.9	63.4
closure voicing duration	81.9	63.4
preceding vowel duration	222.4	140.3
vowel-like release duration	109.8	99.5

is 7.78 years for English and 0.93 year for French with none of them having learned French except for one female subject's one-year and one male subject's twenty-year learning. It is noteworthy that the young group was exposed to English much longer than the old group. This is due to the facts that Korean students have officially started to learn English from 3rd grade in elementary schools since 1997 (e.g. Pae 2002; Ham 2003; Park 2010), and that an earlier learning of English has sometimes been made even in a nursery school. Among the young group, for example, twenty-nine participants started to learn English as early as in a nursery school. In contrast, such an early learning of English was not available to the old group. It was just from middle school when they started to learn English. This is why the average of the old group's English learning is much shorter than that of the young group's.[12]

As stimuli for the perception experiment, the twelve tokens of each source language with six with release of the word-final plosives and six with no release were randomized together with the six fillers at a four-second interval and then repeated four times. A total of 144 trials (18 tokens × 4 repetitions × 2 (English and French)) was presented to each participant in two sessions (i.e. one session for English stimuli and the other for French ones) with a one-minute interval between them. Therefore, the total responses for released and unreleased English and French stimuli were 7,680 (=96 trials (12 tokens × 4 repetitions × 2 (English and French)) × 80 subjects).

Before the experiment, subjects were notified that they would listen to English and then French words pronounced by the native speaker of each language. That is, they were told that they would be listening to English words before the English session and French words before that session. They were unaware of the purpose of our experiment. In a quiet room, each subject was asked to listen to the prepared stimuli, using headphones (Shure SRH440) and to write down what he or she heard in Korean orthography. The perception experiment as well as a brief practice were run using Praat's ExperimentMFC facility.

3 Results

For the comparison of the young and old subjects' vowel insertion after word-final English and French postvocalic plosives, we conducted binomial mixed effect logistic regression models with Generation (Young = 1, Old = 0), Language (English = 1, French = 0), Plosive (Voiceless = 1, Voiced = 0), and all two- and three-way interactions of Generation, Language and Plosive as independent variables and the subjects' vowel insertion (insertion = 1, no insertion = 0) as a dependent variable.[13] The analysis was conducted twice,

[12] One might have noticed that the pronunciation of the English test words *layd*, *layt* and *layk* in (4) is the same as that of the English words *lied*, *light*, and *like*, respectively, thus wondering whether the lexical English words would have affected our subjects' perception. However, when asked whether they had noticed any English words during perception experiments, our ten young subjects (5 male and 5 female) did say that none of them had noticed the presence of any real English words. This is probably because English test words presented randomly together with the six fillers at the four-second interval caused them not to be able to notice the English words when they wrote them in Korean orthography during perception experiments. In addition, in the French test words (4b), there are some lexical words, as in the English ones, that is, /lag/ 'lague'(present tense of verb 'laguer'), /lap/ 'lape'(the present tense of verb 'laper'), /lat/ 'latte', /lak/ 'lac' or 'laque', as pointed out by one of reviewers. However, given our subjects' language background for French and the French lexical words presented randomly together with the six fillers and the other test words at the four-second interval, we assume that both our young and old subjects could not have noticed the lexical French words, as in the English test words, during perception experiments.

[13] The model is as follows for subject *i*'s trial *t*:

$$\ln\left(\frac{prob(VOWEL)}{1-prob(VOWEL)}\right)_{it}$$

$$= \gamma_0 + \gamma_1 GENERATION_i + \gamma_2 LANGUAGE_{it} + \gamma_3 PLOSIVE_{it} + \gamma_4 GENERATION_t \times PLOSIVE_{it}$$
$$+ \gamma_5 GENERATION_i \times LANGUAGE_{it} + \gamma_6 PLOSIVE_{it} \times LANGUAGE_{it}$$
$$+ \gamma_7 GENERATION_j \times PLOSIVE_{it} \times LANGUAGE_{it} + u_j, Var(u_j) = \tau$$

that is, when word-final plosives of the source languages are released and when they are unreleased. Another binomial mixed effect logistic regression models were conducted with Generation and Place of Articulation (Labial, Dorsal with the reference to Coronal), and interactions of Generation by Place of articulation as independent variables and the subjects' vowel insertion as a dependent variable.[14] This analysis was conducted four times (i.e. English-Released, English-Unreleased, French-Released, and French-Unreleased).

Figure 2 presents the proportion of vowel insertion in the interaction of Generation, Language and Plosive when word-final English and French postvocalic plosives are (a) released and (b) unreleased.[15] The generational difference in vowel insertion is obvious

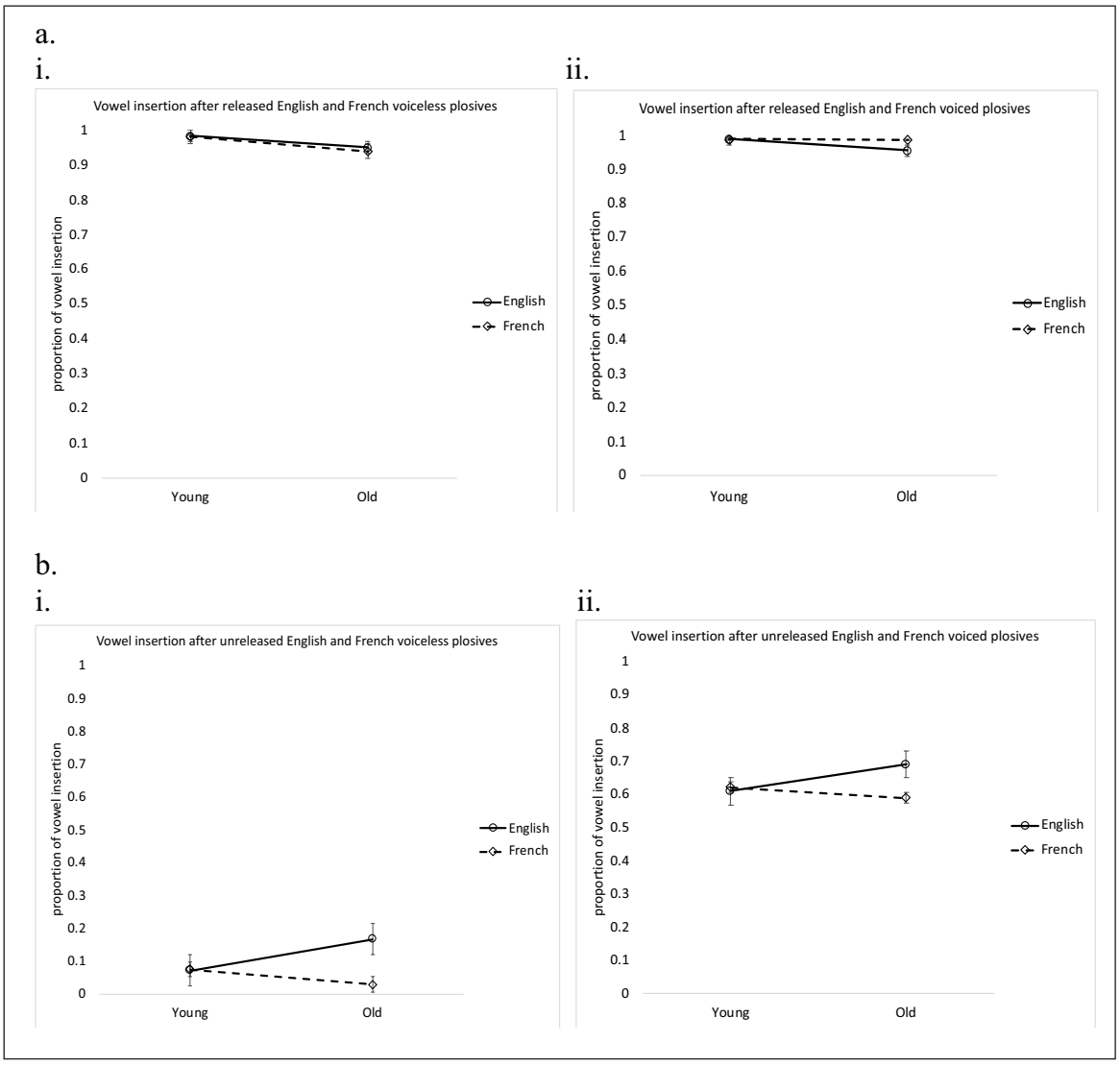


Figure 2: The proportion of vowel insertion in the interaction of Generation, Language and Plosive when word-final English and French postvocalic plosives are **(a)** released and **(b)** unreleased.

[14] The model is as follows for subject *i*'s trial *t*:

$$\ln\left(\frac{prob(VOWEL)}{1-prob(VOWEL)}\right)_{it}$$

$$= \gamma_0 + \gamma_1 GENERATION_i + \gamma_2 CORONAL_{it} + \gamma_3 LABIAL_{it} + \gamma_4 GENERATION_t \times CORONAL_{it}$$
$$+ \gamma_5 GENERATION_i \times LABIAL_{it} + u_j, Var(u_j) = \tau$$

[15] The value "1" on the Y-axis in Figure 2 refers to vowel insertion in all responses, and the value "0" to no vowel insertion in all responses. The same is true of the values on the Y-axis in Figure 3.

after English and French plosives, no matter whether they are voiceless or voiced and no matter whether they are released or unreleased. When the plosives are released and voiceless (Figure 2a i), the young group has no difference in vowel insertion after the plosives, such that the proportion of vowel insertion after the English and French plosives is 0.9842 and 0.9827, respectively. In contrast, that is 0.9506 after the English plosives and 0.9402 after the French plosives in the old group. When the plosives are released and voiced (Figure 2a ii), it is 0.9901 and 0.9886, respectively, in the young group, and 0.9552 and 0.9877 in the old group.

When English and French plosives are released, the interaction of Generation by Language is significant [$t = 2.267, p = 0.023$], and that of Generation by Plosive is also significant [$t = 2.034, p = 0.042$], as in Table 2 (a). The significant interactions indicate that the generational difference in vowel insertion depends on whether the non-native plosives are English or French and also on whether they are voiceless or voiced when they are released. On the other hand, the interaction of Language by Plosive is not significant in the young group [$t = –0.068, p = 0.945$, result not presented in Table 2 (a)] which means that the group's vowel insertion after voiceless and voiced plosives and after the

Table 2: Results of binomial mixed effect logistic regression models with Generation, Language, Plosive when English and French plosives are **(a)** released and **(b)** unreleased. Statistically significant p-values are marked by *.

a.					
	β	**s.e.**	**t**	**p-value**	**Exp (*β*)**
Fixed effect					
Intercept	4.384	0.391	11.22	0.000***	80.161
Generation	0.081	0.579	0.140	0.889	1.084
Language	–1.324	0.372	–3.558	0.000***	0.266
Plosive	–1.628	0.363	–4.482	0.000***	0.196
Plosive*Language	1.526	0.444	3.434	0.001**	4.610
Generation*Plosive	1.203	0.592	2.034	0.042*	3.331
Generation*Language	1.462	0.645	2.267	0.023*	4.316
Generation*Plosive*Language	–1.573	0.812	–1.937	0.053	0.207
Random effect					
Var (uj)	1.572	0.4	z = 3.928	0	
b.					
	β	**s.e.**	**t**	**p-value**	**Exp (*β*)**
Fixed effect					
Intercept	0.364	0.262	1.388	0.165	1.44
Generation	0.134	0.369	0.363	0.717	1.143
Language	0.438	0.152	2.871	0.139	1.549
Plosive	–3.867	0.272	–14.23	0.000***	0.021
Plosive*Language	1.462	0.311	4.697	0.000***	4.314
Generation*Plosive	0.859	0.339	2.531	0.011*	2.361
Generation*Language	–0.490	0.21	–2.329	0.020*	0.613
Generation*Plosive*Language	–1.462	0.412	–3.55	0.000***	0.232
Random effect					
Var (uj)	2.258	0.422	z = 5.356	0	

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

English and French plosives is not significantly different. In contrast, the significant interaction of Language by Plosive in the old group [$t = 3.434$, $p = 0.001$] means that the group differentiates vowel insertion, depending on whether the non-native plosives are English or French and on whether they are voiceless or voiced when they are released.

The young group also has almost the same proportion of vowel insertion after unreleased English and French plosives, regardless of whether they are voiceless or voiced, compared to the old group, as in Figure 2(b). When the plosives are unreleased and voiceless (Figure 2b i), the proportion of vowel insertion after the English and French plosives is 0.0716 and 0.0752, respectively, in the young group and 0.1675 and 0.0292 in the old group. While the old group has more vowel insertion after the English unreleased voiceless plosives than after the French counterparts, the young group does not differentiate them in vowel insertion. Even when the unreleased plosives are voiced (Figure 2b ii), the young group has almost the same proportion of vowel insertion after the English (0.6096) and French (0.6221) plosives, whereas the old group has more vowel insertion after the English (0.6904) than after the French (0.5901) plosives.

When English and French plosives are unreleased, the interaction of Generation by Language and that of Generation by Plosive are significant [$t = –2.329$, $p = 0.020$ for the former; $t = 2.531$, $p = 0.011$ for the latter], as shown in Table 2 (b). The interaction of Generation by Language by Plosive is also significant [$t = –3.55$, $p < 0.001$]. The statistical results indicate that the difference in vowel insertion between the two groups is significantly higher when the plosives are voiceless than when they are voiced, no matter whether they are English or French, and that the old group has more vowel insertion after English plosives than after French ones, whereas the young group has no difference in vowel insertion after the plosives, when they are unreleased.

Figure 3 shows the proportion of vowel insertion in the interaction of Generation and Place of articulation when word-final English and French plosives are (a) released and (b) unreleased. When English plosives are released (Figure 3a i), the proportion of vowel insertion after the coronal, labial and dorsal plosives is 0.9158, 0.9122 and 0.9085, respectively, in the young group and 0.9192, 0.9032 and 0.8242 in the old group. Overall, vowel insertion is not significantly different between the young and old groups [$t = –0.250$, $p = 0.803$], as in Table 3 (a). However, the interaction of Generation and Place of Articulation is significant when the English plosives are dorsal [k, g] [$t = 3.079$, $p = 0.002$], showing that the young group tend to insert vowels more frequently after dorsal plosives than the old group. Pairwise comparisons are not significant in each group, as shown in Table 4 (a).

When English plosives are unreleased (Figure 3b i), the proportion of vowel insertion after the coronal, labial and dorsal plosives is 0.3253, 0.322 and 0.3121, respectively, in the young group and 0.3858, 0.4752 and 0.3714 in the old group. Both age groups are not statistically different in vowel insertion after the plosives [$t = –1.448$, $p = 0.148$], as in Table 3 (b). The interaction of Generation by Place of Articulation is not significant after the unreleased dorsal plosives [k, g] and also after the labial plosives [p, b], as compared to the vowel insertion after the coronal [t, d] [$t = 0.001$, $p = 0.999$ for the former; $t = –1.475$, $p = 0.140$ for the latter]. That is, there is no generational difference in vowel insertion, no matter whether the unreleased English plosives are coronal, labial or dorsal. Pairwise comparisons are not significant in the young group, and the dorsal-labial contrast is significant in the old group, as shown in Table 4 (b).

When French plosives are released (Figure 3a ii), the proportion of vowel insertion after coronal, labial and dorsal plosives is 0.9146, 0.9097 and 0.9097, respectively, in the young group and 0.8921, 0.9096 and 0.886 in the old group. Vowel insertion is not significantly different between the two groups [$t = 1.415$, $p = 0.157$], as in Table 3 (c).

The interaction of Generation by Place of Articulation is not significant either in vowel insertion after the released dorsal plosives [k, g] and also after the labial plosives [p, b], as compared to the vowel insertion after the coronal [t, d] [$t = 0.005$, $p = 0.996$ for the former; $t = –0.995$, $p = 0.320$ for the latter]. That is, vowel insertion is not significantly different between the two groups, no matter whether the released French plosives are coronal, labial or dorsal. Pairwise comparisons are not significant in each group, as in Table 4 (c).

When French plosives are unreleased (Figure 3b ii), the proportion of vowel insertion after the coronal, labial and dorsal plosives is 0.3719, 0.2469 and 0.4399, respectively, in the young group and 0.3229, 0.3 and 0.3155 in the old group. The two groups are not different in vowel insertion after the unreleased French plosives [$t = 1.3$, $p = 0.194$], as in Table 3 (d). The interaction of Generation by Place of Articulation is not significant when the plosives are dorsal [k, g], as compared to vowel insertion after the coronal [t, d] [$t = 1.348$, $p = 0.178$]. However, it is significant when the plosives are labial [$t = –1.988$, $p = 0.047$], showing that the young group tend to insert vowels less frequently after the unreleased French labial plosives than the old group. Pairwise comparisons are not significant in the old group but significant for the dorsal-labial and the coronal-labial contrast in the young group, as shown in Table 4 (d).

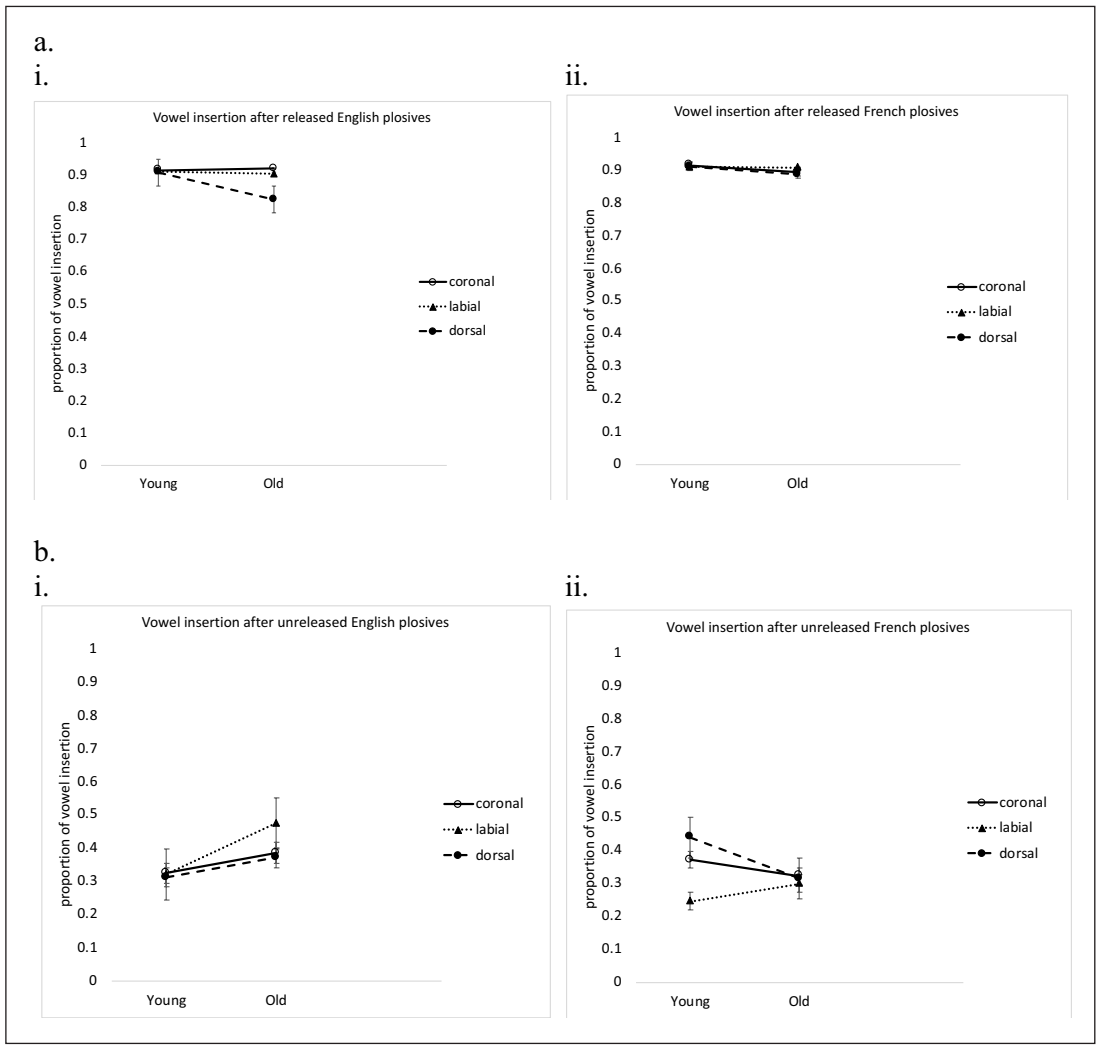


Figure 3: The proportion of vowel insertion in the interaction of Generation and Place of articulation when word-final English and French postvocalic plosives are **(a)** released and **(b)** unreleased.

Table 3: Results of binomial mixed effect logistic regression models with Generation and Place of Articulation when English plosives are **(a)** released and **(b)** unreleased and when French plosives are **(c)** released and **(d)** unreleased. Statistically significant p–values are marked by *.

a.					
	β	**s.e.**	**t**	**p–value**	**Exp (*β*)**
Fixed effect					
Intercept	2.432	0.706	3.446	0.001***	11.381
Generation	−0.046	0.183	−0.250	0.803	0.955
Dorsal	−0.887	0.183	−4.848	0.000***	0.412
Labial	−0.198	0.183	−1.084	0.279	0.820
Generation*Dorsal	0.796	0.259	3.079	0.002**	2.216
Generation*Labial	0.153	0.258	0.591	0.555	1.165
Random effect					
Var (uj)	2.125	0.566	z = 3.758	0	
b.					
	β	**s.e.**	**t**	**p-value**	**Exp (*β*)**
Fixed effect					
Intercept	−0.465	1.675	−0.278	0.781	0.628
Generation	−0.265	0.183	−1.448	0.148	0.768
Dorsal	−0.061	0.183	−0.334	0.739	0.941
Labial	0.366	0.183	2.001	0.046*	1.442
Generation*Dorsal	0.000	0.259	0.001	0.999	1.000
Generation*Labial	−0.381	0.258	−1.475	0.140	0.683
Random effect					
Var (uj)	1.171	0.245	z = 4.784	0	
c.					
	β	**s.e.**	**t**	**p-value**	**Exp (*β*)**
Fixed effect					
Intercept	2.113	0.672	3.144	0.002**	8.271
Generation	0.258	0.183	1.415	0.157	1.295
Dorsal	−0.062	0.183	−0.339	0.734	0.94
Labial	0.196	0.183	1.073	0.283	1.217
Generation*Dorsal	0.001	0.258	0.005	0.996	1.001
Generation*Labial	−0.257	0.259	−0.995	0.320	0.773
Random effect					
Var (uj)	2.733	0.688	z = 3.972	0	
d.					
	β	**s.e.**	**t**	**p-value**	**Exp (*β*)**
Fixed effect					
Intercept	−0.741	14.529	−0.051	0.959	0.477
Generation	0.216	0.166	1.3	0.194	1.242
Dorsal	−0.034	0.17	−0.201	0.841	0.966
Labial	−0.107	0.171	−0.624	0.532	0.899
Generation*Dorsal	0.317	0.235	1.348	0.178	1.373
Generation*Labial	−0.484	0.244	−1.988	0.047*	0.616
Random effect					
Var (uj)	0.852	0.187	z = 4.560	0	

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

Table 4: Results from post-hoc, LSD adjusted pairwise contrast for plosives' place of articulation (Coronal, Labial, Dorsal) in the young and old groups when English plosives are **(a)** released and **(b)** unreleased and when French plosives are **(c)** released and **(d)** unreleased. Statistically significant p-values are marked by *.

a.					
Generation	**Comparisons**	***β***	**s.e.**	**t**	**p-value**
Young	dorsal-labial	−0.004	0.015	−0.247	0.805
	dorsal-coronal	−0.007	0.015	−0.48	0.631
	coronal-labial	0.004	0.015	0.247	0.805
Old	dorsal-labial	−0.079	0.046	−1.732	0.083
	dorsal-coronal	−0.095	0.053	−1.781	0.075
	coronal-labial	0.016	0.017	0.918	0.358
b.					
Generation	**Comparisons**	***β***	**s.e.**	**t**	**p-value**
Young	dorsal-labial	−0.01	0.04	−0.245	0.806
	dorsal-coronal	−0.013	0.041	−0.325	0.745
	coronal-labial	0.003	0.04	0.083	0.934
Old	dorsal-labial	−0.104	0.052	−2.013	0.044*
	dorsal-coronal	−0.014	0.043	−0.331	0.741
	coronal-labial	−0.089	0.049	−1.822	0.069
c.					
Generation	**Comparisons**	***β***	**s.e.**	**t**	**p-value**
Young	dorsal-labial	0	0.015	0	1.000
	dorsal-coronal	0.005	0.015	−0.328	0.743
	coronal-labial	0.005	0.015	0.328	0.743
Old	dorsal-labial	−0.024	0.021	−1.129	0.259
	dorsal-coronal	−0.006	0.018	−0.334	0.738
	coronal-labial	−0.017	0.019	−0.931	0.352
d.					
Generation	**Comparisons**	***β***	**s.e.**	**t**	**p-value**
Young	dorsal-labial	0.193	0.049	3.969	0.000***
	dorsal-coronal	0.068	0.039	1.725	0.085
	coronal-labial	0.125	0.044	2.842	0.005**
Old	dorsal-labial	0.015	0.037	0.421	0.674
	dorsal-coronal	−0.007	0.037	−0.201	0.841
	coronal-labial	0.023	0.037	0.62	0.535

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

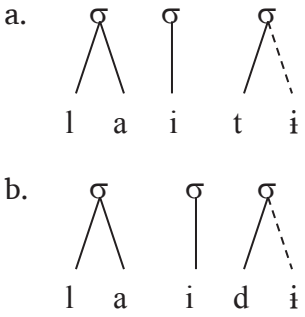
To summarize, the results of the present perception experiment have shown that the release of word-final English and French postvocalic plosives and the voicing of unreleased English and French plosives are key variables for vowel insertion in both age groups. In addition, the young group has no significant difference in vowel insertion after stimuli of both languages, no matter whether the non-native plosives are released or unreleased, no matter whether they are voiceless or voiced and no matter whether they are preceded by the tense vowel [aɪ], as in the English stimuli, or by the non-tense vowel [a], as in the French stimuli. On the other hand, the old group differentiates the plosives in vowel

insertion in the examined contexts, depending on whether they are English or French. However, there are no generational differences in vowel insertion after plosives' places of articulation, no matter whether English and French plosives are released or unreleased. The same is true after coronal, labial and dorsal plosives between the two groups, except when English dorsal plosives are released and when French labial plosives are unreleased. These results are discussed in the next section.

4 Discussion

First, we propose that vowel insertion in accordance with the plosive release and the voicing of unreleased plosives in the present study is accounted for by Korean syllable structure with generational differences made by how two effects – the plosive voicing effect and the vowel-tenseness effect – are involved. In Korean, either a coda consonant or no coda is allowed, and by virtue of the Coda constraint only the lenis plosives [p, t, k] are allowed together with the sonorants [m, n, ŋ, l] in coda position on the surface. For example, when a word-final plosive is released, regardless of whether it is voiced or voiceless in English and French stimuli, the acoustic cue of release is mapped into Korean syllable structure with the vowel insertion /ɨ/ marked in a dotted line, as shown in (5). Note that the English diphthong /aɪ/ is parsed for the two monophtongs /a/ and /i/, because the diphthong is not allowed in Korean. With the vowel insertion /ɨ/, the word-final English plosives [t] and [d] are linked to onset position and borrowed as the aspirated /t^h/ and the lenis /t/, respectively. As a result, the released English stimuli [laɪt] surfaces as [la.i.t^hɨ], and [laɪd] as [la.i.dɨ] with the phonetic voicing of the intervocalic plosive /t/. The same accounts can be made for released French coronal plosives, and also for released English and French labial and dorsal plosives in vowel insertion in both age groups.[16]

(5) Vowel insertion marked in a dotted line after the released English [t] and [d] in (a) *layt* and (b) *layd* in accordance with Korean syllable structure.



The generational differences in Figure 2 (a) can be taken into consideration in (5), depending on how two effects – the plosive voicing effect and the vowel-tenseness effect – are involved. That is, when English and French plosives are released (Figures 2a and 3a), the two effects as well as the plosive place of articulation effect do not play a role in the young group, in that there is no statistical difference in vowel insertion, no matter whether the English and French plosives are voiced or voiceless, no matter whether they are preceded by the tense vowel [aɪ], as in the English stimuli, or by the non-tense vowel [a], as in the French stimuli, and no matter whether the plosives are coronal, labial or dorsal.

As in the young group, the plosive place of articulation effect does not play a role in vowel insertion in the old group when English and French plosives are released

[16] The French plosives [t] and [d] are borrowed as the fortis /t'/ and the lenis /t/, respectively, as in (2) and (3). See H. Kim (2014) for the Korean adaptation of English and French plosives and also for the role of Korean syllable structure.

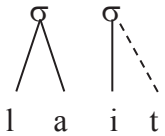
(Figure 3a). However, the old group significantly differentiates vowel insertion, depending on whether the plosives are English or French and on whether they are voiceless or voiced when they are released (Figure 2a). Regarding more vowel insertion after the released English voiceless plosives than after the French counterparts in the old group (Figure 2a i), we suggest that the vowel-tenseness effect overrides the voicing effect after the English plosives in the group. When English and French plosives are released and voiced (Figure 2a ii), the old group has more vowel insertion after the French plosives than after the English ones, which leads to the suggestion that the voicing effect results in more vowel insertion after the former.

When English and French plosives are unreleased (Figures 2b and 3b), the voicing effect plays a role in both age groups with more vowel insertion after unreleased English and French voiced plosives than after their voiceless counterparts with no role of the plosive place of articulation effect. However, in addition to the voicing effect, the vowel-tenseness effect does take place after unreleased English plosives in the old group, in that vowel insertion occurs more after the English plosives than after the unreleased French ones in the old group, no matter whether the plosives are voiceless or voiced. That is, the combined effects of plosive voicing and vowel-tenseness are at play after unreleased English plosives in the old group.

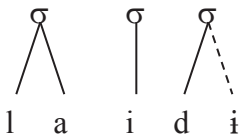
Examples of no vowel insertion and vowel insertion after the unreleased English postvocalic [t] and [d], respectively, are given in (6). The unreleased [t] for the English stimuli [laɪt] is linked to a coda in conformity with Korean syllable structure, as in (6a), whereas the unreleased [d] for the English stimuli [laɪd] is parsed to an onset with the vowel insertion /ɨ/ by virtue of the plosive voicing effect, as in (6b). The coda [t] which is borrowed as /t^{h}/ is stored as /s/ in lexicon due to the Korean lexical restriction. Then, the coda /s/ is neutralized into /t/ by Coda neutralization in Korean. Thus, the unreleased English stimuli [laɪt] surfaces as [la.it]. As for the unreleased English [d], the lenis /t/ surfaces as [d] due to the phonetic voicing of the lenis plosive in intervocalic position, as in [la.i.dɨ].

(6) No vowel insertion and vowel insertion in the unreleased English [t] and [d] in (a) *layt* and (b) *layd*, respectively, in accordance with Korean syllable structure.

a.



b.



The same accounts can be made for unreleased French coronal plosives, and also for unreleased English and French labial and dorsal plosives in the young group. In the case of the old group, however, vowel insertion is expected to occur more after the unreleased English voiceless and voiced plosives than after the French counterparts due to the vowel-tenseness effect.

Second, as for no difference in vowel insertion after word-final English and French postvocalic plosives in the young group, as shown in Figure 2, we suggest that it is a case of contact-induced borrowing change resulting from the English/French contact differences over the last two decades in Korean society. That is, the young Koreans do not differently perceive English and French plosives in vowel insertion due to more contact to English and less contact to French, as compared to the old group. Though almost all our subjects

in the two groups had never learned French, French contact has gradually weakened over time, whereas English contact has increased in Korean society.

To take an example, the comparison of general high school students taking English and French makes it obvious that young Koreans have had much less contact with French than old Koreans, as shown in Figure 4.[17] There is no change in overall frequency of students taking English either in 1991 or in 2012, because it has been mandatory for all students to take English in general high schools since 1954 (e.g. Bae 2002; Ham 2003; Park 2010).[18] However, the number of students taking French as a second foreign language in general high schools was 318,345 (22.6%) among the total of 1,406,891 students in 1991.[19] Yet, it has significantly reduced to 8,229 (0.6%) among 1,390,905 students in 2012 ($\chi^2 = 262482.51$ (1), $p < 0.001$).

As for the significant reduction in the number of students taking French in 2012, we may consider two major changes. One is that French has not been as popular as before, because young Koreans have preferred Chinese or Japanese to French. In 2012, for example, the number of students taking Japanese as a second foreign language in general high schools was 181,578 (13.1%).[20] The other change is that French was not included for college entrance exams when the young group was in high school and thus that it has been

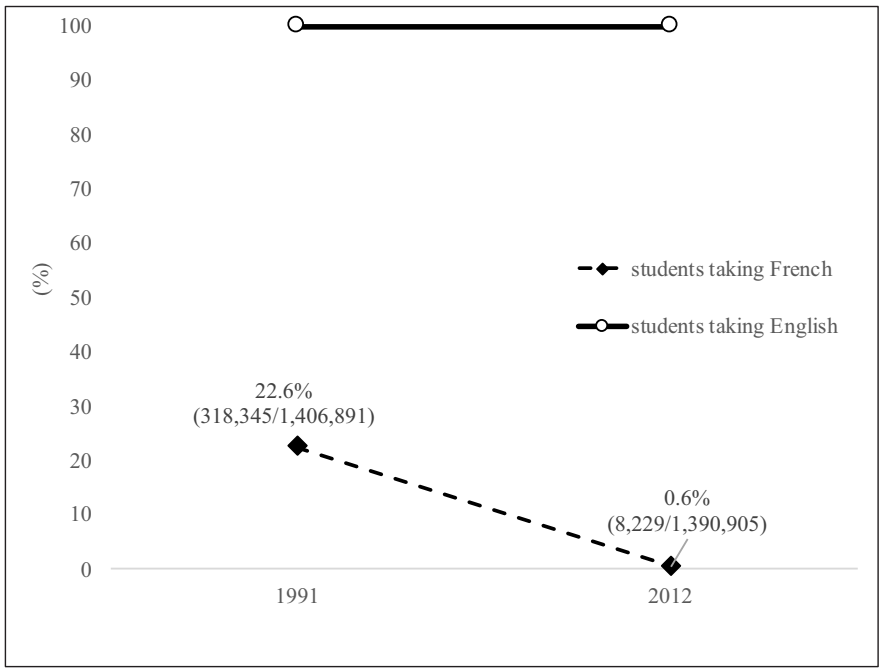


Figure 4: The comparison of students taking English and French in general high schools in the year 1991 vs. 2012 based on the database of the Korean Educational Statistics Service (KESS).

[17] According to Korean Educational Statistics Service (henceforth, KESS), the data for students taking English and French in general high schools are available from the year of 1991 through 2012. Thus, the 1970s and 1980s data are not included in Figure 4 when French had been one of the popular second foreign languages besides English in general high schools for our old group.

[18] American English was chosen in South Korea's secondary school curriculum since 1954. The selection of American English for English-language education in Korea was influenced by the major role of the U.S. during the Korean war (1950–1953).

[19] It is since 1969 that Korean students have been able to learn another foreign language among French, German, Japanese, etc. in high schools (e.g. Ham 2003).

[20] The students' preference for Japanese over French also affected the number of teachers for the two languages in general high schools. That is, the number of teachers for French and that for Japanese in 2012 was 102 (0.1%) and 1,654 (1.9%), respectively, among the total of 89,538 teachers. In 1991, however, that for French was 757 (1.3%) among the total of 58,757 teachers.

taught two or three hours per week since 2009 in the second year (that is, the 11th year), a year and a half before they take college entrance exams (e.g. M. Kim 2014). Yet, when the old group was in high school, French was optionally included for college entrance exams especially in privileged universities. In addition, according to the database of Ministry of Education (e.g. Ham 2003), if students selected French in general high schools, they learned it for three or four hours per week from their 10th year in the 1970s when old Koreans were high school students.

Even in universities, young Koreans have lower exposure to French than old Koreans. The number of undergraduates in English departments was 6,151 in 1977 and has increased to 42,787 in 2017, around seven times higher compared to forty years ago, as shown in Figure 5. On the other hand, the number of undergraduates in French departments was 1,139 in 1977 and continued to increase until 1986 when the total number of undergraduates in the departments was 14,899. It has, however, gradually decreased since 1986. Especially since 2002, it has remained around 7,000. Therefore, the difference between undergraduates in English and French departments in 2017 is 35,522 with undergraduates in English departments being around five times higher as many as those in French departments.

The comparison of Korean students studying in English-speaking countries to those in France further reveals that young Koreans have experienced much more contact with English than with French. According to the data from the Korean Ministry of Education, many more Korean students have studied in English-speaking countries than in France. As in Figure 6, the percentage of Korean undergraduates or graduates studying in English speaking countries such as the U.S., Canada, England, Australia and New Zealand has been above or around 50% from 2001 through 2016, whereas that of those studying in France has been less than 10%.[21]

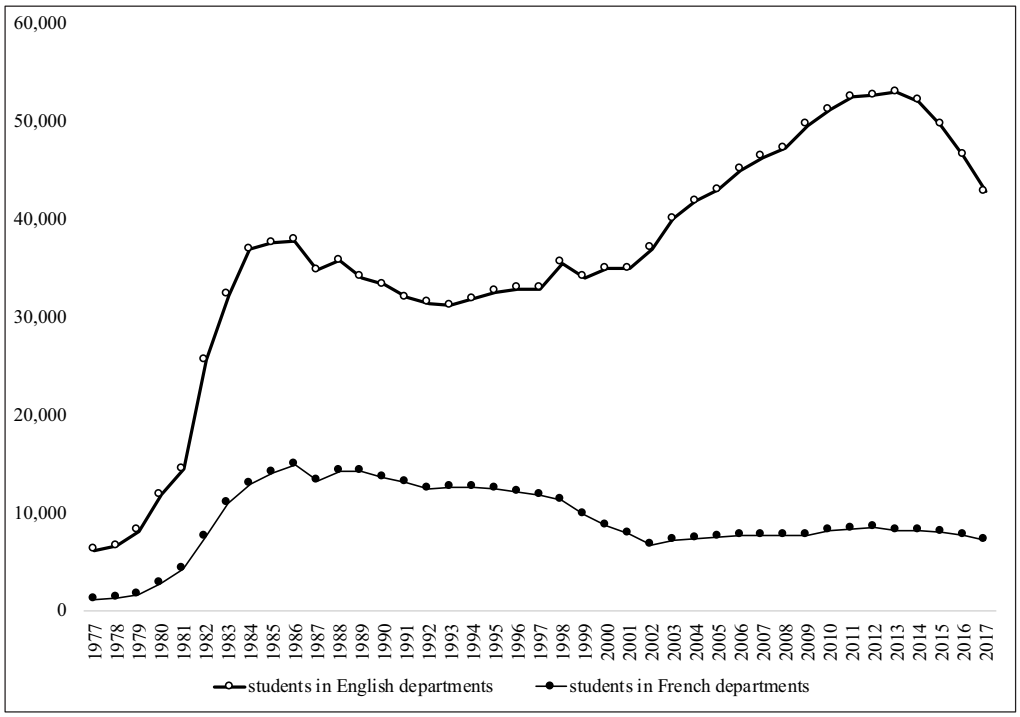


Figure 5: The comparison of undergraduates in English and French departments from the year 1977 through 2017 based on the KESS database.

[21] The data for the year 2002 in Figure 6 are not available in the KESS database.

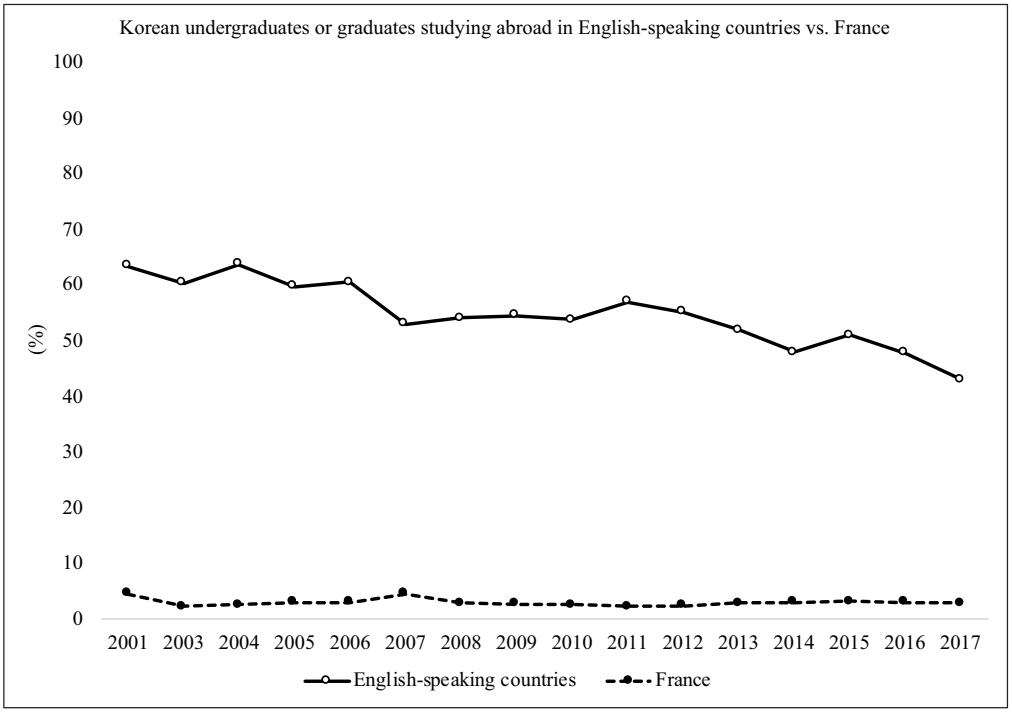


Figure 6: The comparison of Korean undergraduates and graduates studying in English-speaking countries such as the U.S., Canada, England, Australia and New Zealand to those in France from the year 2001 through 2017 based on the KESS database.

Table 5: The number and percentage of Korean students studying in **(a)** English-speaking countries and **(b)** France among the total of Korean students studying abroad for their undergraduate/graduate studies and language training in 2017 based on the KESS database.

a.	
U.S.	61,007
Canada	8,735
England	11,065
Australia	16,670
New Zealand	6,060
(sum)	**103,537**
(%)	43.2%
b.	
France	**6,655**
(%)	2.8%
Total number of Korean undergraduates and graduates studying abroad in 2017	**239,824**

More details on Korean students studying abroad in 2017 are presented in Table 5. Korean undergraduates and graduates studying in the U.S., Canada, England, Australia and New Zealand are 103,537 (43.2%), whereas those studying in France are 6,655 (2.8%) in 2017. What is noteworthy is that among those studying in the English-speaking countries in Table 5, the percentage of those studying in the U.S. is much higher (59%) than that of those studying in the other four countries. The English-speaking countries have

also been preferred to France when Korean elementary, middle and high school students study abroad. As shown in Figure 7, those who went to the English-speaking countries in 2007 were 25,502 students, whereas 179 students went to France in the same year.[22] Since 2007, the number of students who go to the English-speaking countries has gradually decreased, such that it is 8,764 in 2017. In contrast, the number of students who go to France has almost been stable for the past ten years, and 114 students went to France in the year 2017.

Less contact with French by young Koreans had yielded to less interest in French culture. For example, French songs, that is, *chansons*, were popular, and many French singers such as Edith Piaf, Juliette Greco, Yves Montand, Jacques Brel and George Moustaki were very familiar to old Koreans, being often broadcasted in French on TV or radio programs (Hwang 2013). In addition, there was an attempt to sing popular Korean songs in French. According to the reports from Kyunghang Daily Newspaper on November 16, 1991, and on February 15, 1992, Mija Jeon whose first name has been known as the French name *Marie* released her LPs in which Korean songs were sung in French, had her own concert at the Korean cultural center in Paris and participated in song festivals in France. However, such cultural activities have not been continued due to young Koreans' less contact with French.

While having much less contact with French, young Koreans have more direct contract with English than old Koreans. Though it has been mandatory for all students to take English in general high schools, no matter whether they are old or young, old Koreans learned English through books with no use of audio and/or visual teaching materials when they started to learn English in middle school (e.g. Pae 2002; Ham 2003; Park 2010). Except for the case that English was taught by Peace Corps volunteers

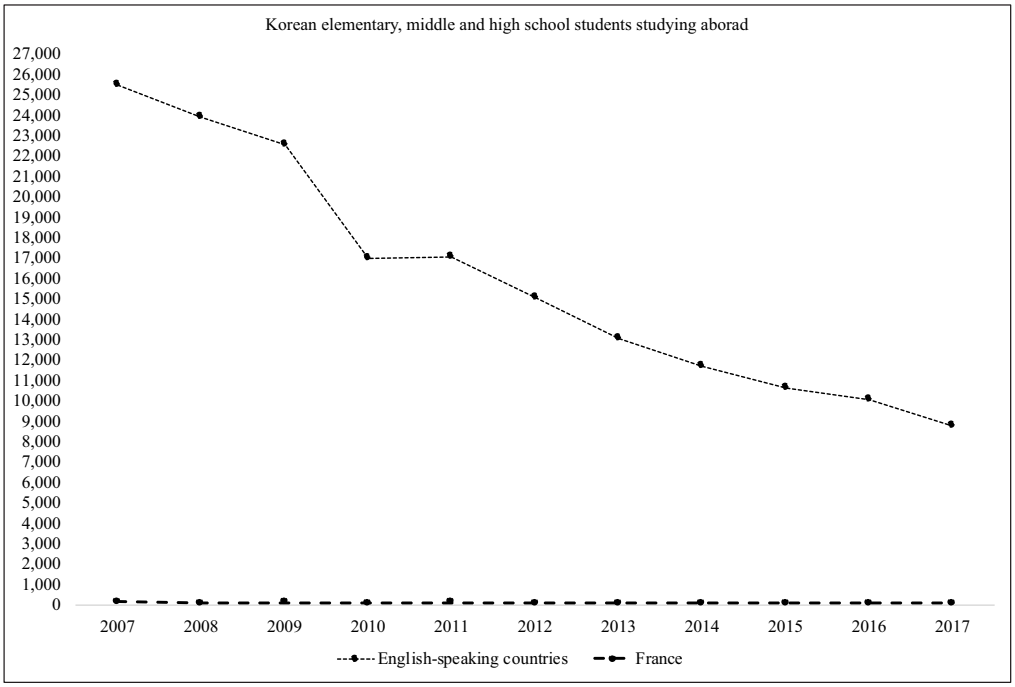


Figure 7: The comparison of Korean elementary, middle and high school students going to English-speaking countries such as the U.S., Canada, England, Australia and New Zealand and to France from 2007 through 2017 based on the KESS database.

[22] It was since the year of 2000 that Korean elementary, middle and high school students have been officially allowed to study abroad. But the data before the year of 2007 were not available in the KESS database.

(1966–1981) in rural areas, old Koreans mostly learned English from Korean teachers who hardly had direct contact with English and who also learned English through books.[23] Therefore, the main focus in learning English was grammar-oriented when old Koreans were in high school as well as in middle school, such that reading/understanding English texts was most important in evaluating students' English.

In contrast, young Koreans have more direct contract with English than old Koreans. Multimedia-assisted English classes have been available with classrooms equipped with TV screens, computers and internet, which had never been expected when old Koreans learned English in middle or high school. More native speakers of English in universities have also provided young Koreans with more direct contact with English. According to the KESS database, 1,398 Americans taught English in universities in 2017, which is around fourteen times as many as those in 1975. On the other hand, the number of native speakers of French working in universities is 65 in 2017. Moreover, as shown in Figure 7, many elementary, middle and high school students have been studying abroad in the English-speaking countries for the past ten years. In contrast, it was quite rare to do so when old Koreans were elementary, middle or high school students. This is because they were strictly screened by a national exam for their qualification of studying abroad until 1989 when any students began to be allowed to study abroad once they graduated from high schools.

Furthermore, young Koreans' more direct contact with English may have been motivated by the drastic expansion of Korean economic development with the U.S. For example, the scale of Korea's trade with the U.S. has been expanded much more than with France. According to the database from the International Monetary Fund, Korea's trade with the U.S. has drastically increased since the year 1980, compared to that with France, as illustrated in Figure 8. Korea's exports to the U.S. in 2015 were more than 70 billion in US dollars, which is thirty-five times as much as that to France which were around 2 billion. Its imports from the U.S. in the same year were more than 44 billion, which is around seven times as much as that from France which were less than 7 billion. Much

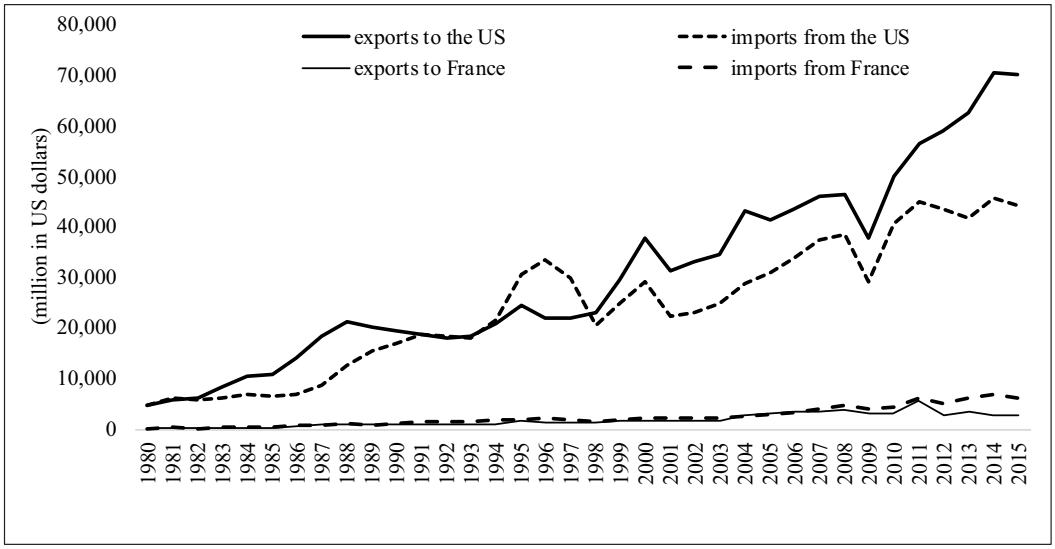


Figure 8: Korean exports to the U.S. and France and imports from the two countries from the year 1980 through the year 2015 based on the database from the International Monetary Fund.

[23] According to the Bureau of International Information Program (2012) and Jung (2008), approximately 2,500 Peace Corps volunteers served in Korea between 1966 and 1981 to help teach English in provincial areas and provide medical, agricultural and industrial support to Koreans.

more trade with the U.S. has led to more recruitment of English-speaking Koreans in both national and private companies, most of which have conducted job interviews in English. This has driven young Koreans' more direct contact with English as well as more undergraduates in English departments and more Korean students studying abroad, especially in the U.S., as shown in Figures 5, 6 and 7 and Table 5.

Consequently, given the English/French contact differences over time in Korean society, we propose that no significant difference in vowel insertion after English and French postvocalic plosives in the young group can be accounted for as a case of contact-induced borrowing change.

In favor of this account, supplementary data can be provided from the corpus-based study of H. Kim (2017b). As shown in (7a), the word-final English postvocalic sonorants [m, n, l] are always borrowed as coda consonants with no vowel insertion, just like the English dorsal nasal [ŋ] in conformity with Korean syllable structure, not only in the early 1990s data but also in the 2011 data.[24] Neither vowel insertion nor variable insertion occurs after the word-final English postvocalic sonorants. On the other hand, the French sonoronants [m, n, l] are borrowed as either geminates /mm, nn, ll/ with vowel insertion due to the release of the sonorants or /m, n, l/ with no vowel insertion, and in the case of a French word ending in a nasalized vowel which is borrowed as a vowel + /ŋ/, the dorsal nasal is always borrowed with no vowel insertion in the early 1990s data, as in (7b).

(7) Korean adaptation of word-final (a) English postvocalic sonorants [m, n, ŋ, l] and (b) French [m, n, l] and a nasalized vowel which is borrowed as a vowel + /ŋ/ in the early 1990s data (H. Kim 2017b)

a.

English words	Korean adapted forms	
	i. Epenthesis	ii. No epenthesis
time		tʰa.im
room		lum
man		mæn
green		kɨ.lin
ball		pol
model		mo.tɛl
jogging		tso.kiŋ
bang		pæŋ

b.

French words	Korean adapted forms		
	i. Epenthesis		ii. No epenthesis
dame	tam.mɨ		
Sorbonne	s'o.lɨ.pon.nɨ		
Cécile	s'ɛ.s'il.lɨ		
Roxane	lok.kʰɨ.s'an.nɨ	(or lok.s'an.nɨ)	
Guillaum	kwi.i.jom.mɨ	~	kwi.i.jom
Nicole	ni.kʰol.lɨ	~	ni.k'ol
centime			s'aŋ.tʰim
guillotine			ki.jo.tʰin
nouvelle			nu.pɛl
Napoléon			na.pʰol.lɛ.oŋ
chanson			s'jaŋ.s'oŋ

[24] Recall that Korean allows only the three lenis plosives [p, t, k] and the four sonorants [m, n, ŋ, l] in coda position on the surface by virtue of the Coda constraint.

According to H. Kim (2017b), however, the overall frequency of final vowel insertion after word-final French postvocalic sonorants is significantly decreased, and that of no vowel insertion is significantly increased in the 2011 French data, as compared to the early 1990s French data. This indicates that word-final French postvocalic sonorants are perceived more like their English counterparts with no vowel insertion by young Koreans, regardless of whether the French sonorants are released or not, as word-final French postvocalic plosives are in the present study.

To sum up, based on the results of the present experimental data, we have proposed that vowel insertion after the release of English and French postvocalic plosives and after the voicing of unreleased English and French plosives in both age groups are accounted for by Korean syllable structure, as in (5) and (6), with the two effects – the plosive voicing effect and the vowel-tenseness effect – differently involved in the groups. We have also proposed that no significant difference in vowel insertion after word-final English and French plosives in the young group is a case of contact-induced borrowing change resulting from the English/French contact differences over time in Korean society. Some theoretical implications can be discussed in the next section.

5 Theoretical implications

First, the role of language contact differences over time, as in the young group's vowel insertion in the present study, has been observed in the literature (e.g. Haugen 1950; Weinreich 1968; Labov 1972; 2001; 2007; Hualde 1993; Smith 2006; Crawford 2009; Kang 2009; Hamann & Li 2016). Japanese adaptation of the English /t/ and /d/ before /i/ is another case that language contact differences over time play a role in loanword adaptation. According to Crawford's (2009) survey of Arakawa (1977), English words with the coronal consonants before /i/ were usually borrowed with the palatalization of /t/ and /d/ into /tʃ/ and /dʒ/, respectively, (e.g. /tʃiketto/ 'ticket', /ɾedʒi:/ 'lady') before 1890, that is, in the period of 1870–1889 when the modernization of Japan began during the Meiji era with Japanese contact with the outside world increasing since 1870.[25] Yet, after 1890 when mandatory English-language education started in Japan, /ti/ and /di/ became allowable sequences in loanwords with the attested rate of coronal palatalization in new loanwords decreased. To be specific, in the period of 1890–1930, variation between /tʃi/ and /ti/, /dʒ/ and /di/ adaptations occurred, and /ti/ and /di/ sequences were most acceptable after about 1930. Thus, the more contact with English, the less palatalization of the English sequences /ti/ and /di/ in Japanese adaptation.

Language contact differences also play a role synchronically in loanword adaptation (e.g. Poplack et al. 1988; Lev-Ari & Peperkamp 2014). For example, Poplack et al. (1988) investigated the French spoken in the national capital region of Canada (Ottawa and Hull) and the effects of English contact on it. They have found that English loanwords are used more in anglophone Ottawa (Ontario) than in francophone Hull (Quebec). In particular, the three Ottawa neighborhoods of the West End, Basse-Ville and Vanier are different in the proportion of their residents claiming English mother-tongue status, such that the West End has fewer French than English speakers, whereas Vanier has three times as many francophones as anglophones, with Basse-Ville falling somewhere in between. They have found that English loanwords are used more in the West End than in the other two in Ottawa. The difference in borrowing English words between Ottawa and Hull and between the West End and the other neighborhoods in Ottawa has been attributed to

[25] In Japanese native words, the plosives /t, d/ change to the palato-alveolar affricates [tʃ, dʒ] on the surface, as in /battiri/ → [batʃ:iri] 'perfectly' (Shibatani 1990).

the amount of exposure to English. As a result, the more contact with English, the more English borrowings.[26]

Second, with no consideration of English/French contact differences over time, it would be hard to account for why the young group in the present study has no difference in vowel insertion after word-final English and French postvocalic plosives. If speakers of a recipient language (L1) perceive and produce the native segment which most closely approximates the input of a donor language (L2) in articulatory and/or acoustic properties, when confronted with an L2 sound (e.g. Silverman 1992; Best 1995; Steriade 2001; Kenstowicz 2003; Peperkamp & Dupoux 2003; Kang 2003), the generational difference in the present study (Figure 2) would not be expected at all. For example, since French words are usually released with the schwa [ə] in word-final position (e.g. Tranel 1987), vowel epenthesis after word-final French postvocalic plosives is perceptually similar to the French plosives in Korean adaptation, no matter whether Koreans are old or young. But this is not the case. In addition, one might say that as the English and French stimuli are phonetically similar in terms of the release duration and release quality in Table 1, they would be assimilated identically in the young group. Thus, the young group behaved in the same way for English and French postvocalic plosives. However, this phonetic approximation view cannot explain why the old group differentiated English and French postvocalic plosives in vowel insertion, compared to the young group.

The young group's vowel insertion in the present study cannot be accounted for either in the phonological view (e.g. Paradis & LaCharité 1997; LaCharité & Paradis 2005; Paradis & Tremblay 2009). If loanword adaptation is based on phonological category mappings between the L2 and L1 languages, only no vowel insertion would be expected in Korean adaptation of word-final English and French postvocalic plosives in both the young and old groups, in that word-final plosives are allowed in Korean phonology, as in the phonology of the source languages. Moreover, neither the phonological view nor the phonetic approximation view accounts for why there is the [t] ~ [s] alternation in Korean adaptation (e.g. [a.i.pʰat] 'iPod'~ [a.i.pʰa.sʲi] 'iPod' + Nom.; [aŋ.t'i.wa.nɛt] '(Marie) Antoinette' ~ [aŋ.t'i.wa.nɛ.sʲi] '(Marie) Antoinette' + Nom.), as in (2) and (3), respectively).

No difference in vowel insertion after word-final English and French postvocalic plosives in the young group is not expected either under the view that L2 acoustic outputs are computed by an L1 grammar (e.g. Polivanov 1931; 1974; Trubetzkoy 1939; Hyman 1970; Peperkamp 2005; Yip 2006; H. Kim 2006; 2007; 2008; 2009; 2014; 2017a; 2019). This is because L1 grammar per se does not provide a complete account of why the young group has no difference in vowel insertion, regardless of whether English and French plosives are released or unreleased, regardless of whether they are voiced or voiceless and regardless of whether they are preceded by the tense vowel [aɪ], as in the English stimuli, or by the non-tense vowel [a], as in the French stimuli. With no consideration of English/French contact differences over time in Korean society, the account would predict either vowel insertion or no vowel insertion after word-final English and French plosives, depending on whether they are released or unreleased, no matter whether Korean speakers are young or old.

Third, the present study has shown that the plosive release and the voicing of unreleased plosives are key variables for vowel insertion after word-final English and French

[26] See also Kwon (2017) for the effect of different experience of English in vowel insertion after English nonsense words in her experimental study where thirty-nine native speakers of Korean were divided into three groups (i.e. fifteen near-monolinguals, ten early-bilinguals and fourteen late-bilinguals), depending on how long the subjects had exposed to English.

postvocalic plosives in both age groups. So far in the literature the three effects – the plosive voicing effect, the vowel-tenseness effect and the plosive place of articulation effect – have been reported in vowel insertion after word-final English postvocalic plosives. However, in the present study, the three effects do not play a role in the young group, when either English or French plosives are released. In the old group, the plosive place of articulation effect does not play a role either, as in the young group. But the other two effects play a role in vowel insertion in the old group. When English and French plosives are unreleased, the plosive voicing effect does take place in both age groups with no role of the plosive place of articulation effect. However, in addition to the voicing effect, the vowel-tenseness effect does play a role in the old group with more vowel insertion after unreleased English plosives, regardless of whether the plosives are voiced or voiceless. Therefore, the three effects reported in the literature could be further specified, depending on whether word-final English and French postvocalic plosives are released or unreleased, whether unreleased English and French postvocalic plosives are voiced or voiceless, whether the unreleased plosives are preceded by the tense vowel [aɪ], as in the English stimuli, or by the non-tense vowel [a], as in the French stimuli, and whether Korean speakers are young or old, as in the present study.

6 Conclusion

In order to investigate whether there are any differences in young vs. old Koreans' vowel insertion after word-final English and French postvocalic plosives, we conducted a perception experiment. 40 Koreans who were born before 1960 and another 40 Koreans who were born after 1989 were recruited with 20 male and 20 female subjects in each group.

Our perception experiment has shown that the release of word-final English and French postvocalic plosives and the voicing of unreleased plosives are key variables for vowel insertion in both age groups. It has also shown that the young group has no significant difference in vowel insertion after English and French plosives, regardless of whether the plosives are released or unreleased, whether they are voiceless or voiced and whether they are preceded by the tense vowel [aɪ], as in the English stimuli, or by the non-tense vowel [a], as in the French stimuli. On the other hand, the old group differentiates English and French plosives in vowel insertion in the examined contexts. However, there are no generational differences in vowel insertion after places of articulation of English/French plosives, no matter whether they are released or unreleased.

Based on the results, we have proposed that vowel insertion after the plosive release and after the voicing of unreleased plosives in both age groups is accounted for by Korean syllable structure with generational differences made by how the two effects – the plosive voicing effect and the vowel-tenseness effect – are involved. We have also proposed that no significant difference in vowel insertion after word-final English and French plosives in the young group, compared to the old group, is a case of contact-induced borrowing change resulting from the English/French contact differences over time in Korean society.

To conclude, the present study is the first to examine whether young vs. old Koreans are different in vowel insertion after word-final English and French postvocalic plosives in their perception of the non-native plosives which are released or unreleased. The generational difference found in the present study is reminiscent of the diachronic data survey in H. Kim (2015; 2017b), according to which the overall frequency of final vowel insertion is significantly decreased, whereas that of no vowel insertion is significantly increased in the 2011 data, as compared to the early 1990s data, no matter whether word-final postvocalic plosives are English or French.

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Competing Interests

The authors have no competing interests to declare.

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