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Authors

Kang, Yoonjung

Han, Sungwoo

Kochetov, Alexei

et al.

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Variation in the Place of Articulation of Korean Affricates Revisited*

YOONJUNG KANG

University of Toronto Scarborough/University of Toronto

SUNGWOO HAN

Inha University

ALEXEI KOCHETOV

University of Toronto

EUN JONG KONG

Korea Aerospace University

1 Introduction

The place of articulation of Korean coronal affricates has long been a topic of interest in Korean linguistics. It is widely assumed that these affricates were dental, apical, or alveolar (‘anterior’) in Middle Korean and have since shifted to a palatal, postalveolar, or alveolo-palatal (‘posterior’) place of articulation in all contemporary South Korean dialects, while remaining anterior in much of the North Korean dialect area (Kwak 2001; Lee 1998; Lee and Ramsey 2011; Martin 1992).

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Phonological evidence for affricate place of articulation has primarily come from their interaction with the high front vocoids /i/ and /j/, in particular the co-occurrence restriction between affricates and the palatal glide /j/: /j/ is lost (‘yod-dropping’) in Modern Korean following affricates, a pattern commonly attributed to the shift of affricates from an anterior to a posterior place of articulation. Loanword evidence has also figured prominently in this discussion: the presence of /j/ in the adaptation of foreign posterior affricates has been argued to support an anterior place of articulation for Korean affricates.

In this paper, we review the relevant phonological evidence from the literature on yod-dropping as well as loanword adaptation and discuss challenges to the traditional account—namely, that historical yod-dropping affected other anterior coronal consonants as well, and that a posterior place of articulation is not a necessary condition for historical yod-dropping. We propose that there are two different types of co-occurrence restrictions at play. One is a phonetically grounded, gradient restriction that is sensitive to the paradigmatic contrast between strings of sounds and induces yod-dropping selectively in posterior affricate contexts (tɛ vs. tɛj) where paradigmatic contrast is particularly threatened. The other is a lexical constraint that is extrapolated from this phonetically grounded pattern and generalizes yod-dropping to all post-coronal contexts in Modern Korean. It is the former, phonetically grounded restriction that becomes visible when post-coronal yod is reintroduced in loanwords, but yod-dropping selectively targets posterior affricates. We provide an Optimality-Theoretic formalization of both the synchronic and diachronic variation.

We then present data from a production and interlanguage perception experiment involving speakers of four Korean dialects: Seoul Korean, Toronto Heritage Korean, and two Chinese Korean dialects with anterior affricate places of articulation. We examine the extent to which differences in place of articulation across dialects are reflected in interlanguage mapping. We find that, in dialects where affricates exhibit a more anterior place of articulation, speakers are more likely to map posterior affricates to <j> than anterior affricates in interlanguage mapping tasks. This correlation between affricates’ place of articulation and the use of contrastive <j> supports the phonetically grounded version of the co-occurrence restriction, which predicts a systematic relationship between coronal place of articulation and yod-dropping.

A note on transcription symbols is in order. In this paper, we use <c>-based transcriptions to refer to affricates without committing to specific place features, with angled brackets representing orthographic forms. For phonemic and phonetic transcriptions of anterior and posterior affricates, we use [ts] and [tɛ], respectively, with appropriate laryngeal features, without committing to finer-grained distinctions within either category. Note that posterior affricates have also been transcribed as [tʃ] and [tʃ̞], among others. We also do not mark tone, pitch accent, or vowel length in our transcriptions.

2 Middle Korean to Modern Korean

Korean affricates are widely taken to have had an anterior place of articulation—variously described as dental, apical, or alveolar—in Middle Korean. Some of the earliest evidence for this view comes from Mongolian loanwords that entered the language during a period of intense contact with Middle Mongolian in the 13th century. These data are drawn from bilingual alphabetic works that translate or transliterate Chinese literature and characters into Hangul in Late Middle

Korean (LMK; 15th–16th centuries) (Lee 1964, 1998; Lee and Ramsey 2011). Examples are shown in (1).¹

(1) Mongolian loanwords in Middle Korean

	Middle Korean	Middle/Written Mongolian	
a.	<cjΛLtaməL>	/dʒe'erde/	'red horse'
	<c ^h juLac ^h i>	/tʃuratʃi/	'military musician who blows on a triton shell'
b.	<sjonkoL>	/ʃinqor, ʃonqor/	'[a variant of] falcon'

(Lee 1964)

As shown in (1a), Mongolian posterior affricates /dʒ/ and /tʃ/ are written with <j>—as <cj> and <c^hj>, respectively—in Middle Korean texts. Lee (1998: 110) explains this pattern by arguing that Middle Korean affricates had an anterior coronal place of articulation, and that /j/ was added in loanword adaptation to approximate the posterior place of articulation of the Mongolian affricates. A posterior fricative is similarly adapted with <j> in (1b). Although Lee (1998) does not specify precisely how the addition of /j/ yields a more posterior realization, it is plausible that an allophonic rule palatalizing anterior sibilants before /j/ was already active in the 13th-century Korean, resulting in a posterior surface realization that more closely approximated the Mongolian place of articulation.

Another line of evidence for the LMK affricate place of articulation comes from the fact that LMK permitted affricate + /j/ sequences, which contrasted with simplex affricates, forming (near-)minimal pairs such as those in (2). The affricates are assumed to have been underlyingly anterior and thus did not share a palatal place feature with the glide; allophonic palatalization of affricates before /j/ then gave rise to a surface contrast between [tsV] and [tɕjV] (Lee, 1998; Lee and Ramsey, 2011). This contrast has since been lost, with post-affricate yod deleted in Contemporary Korean.

(2) Cooccurrence of affricates and palatal glides in LMK

a.	<caŋ>	/tsaŋ/	[tsaŋ]	'seal'
	<cjaŋ>	/tsjaŋ/	[tɕjaŋ] ²	'soy sauce'
	<c ^h o>	/ts ^h o/	[ts ^h o]	'vinegar'
	<c ^h jo>	/ts ^h jo/	[tɕ ^h jo]	'candle'
	<cΛ>	/tsΛ/	[tsΛ]	'oneself'
	<cjΛ>	/tsjΛ/	[tɕjΛ]	'chopsticks'
b.	<cΛc>	/tsΛts-/	[tsΛts]	'to wet'
	<cjΛc>	/tsjΛts/	[tɕjΛts]	'milk'
	<cuk>	/tsuk-/	[tsuk]	'to die'
	<cjuk>	/tsjuk/	[tɕjuk]	'porridge'
	<c ^h um>	/ts ^h um/	[ts ^h um]	'dance'

(Lee 1998; Lee and Ramsey 2011)

¹ Korean orthographic transcriptions largely follow standard IPA conventions, except for <L>, which represents a single liquid phoneme that varies between lateral and tap realizations depending on the context.

² The literature is not in agreement as to whether [j] is realized on the surface as a distinct segment in contexts where it allophonically palatalizes a preceding coronal. Here, we follow Lee and Ramsey (2011) in transcribing [j] in these forms, both here and throughout the paper. An alternative analysis, in which [j] fuses with the preceding coronal, is also compatible with our proposed analysis.

<c^hjuma> /ts^hjuma/ [tɕ^hjuma] ‘skirt’ (Huh 1964)

It has been conjectured that sometime during Modern Korean (ModK; 17th–19th centuries), these allophonic palatal variants generalized to all environments, such that the anterior affricates /ts, ts^h/ of LMK became phonemically posterior /tɕ, tɕ^h/ in ModK across all South Korean dialects. This change, in turn, led to the loss of contrastive palatal glides following affricates (Huh 1964; Kwak 2001; Lee 1972 [1961]; Lee and Ramsey 2011). Evidence for this change comes from the interchangeable use of yod-ful and yod-less spellings in post-affricate position in ModK texts (Lee, 1998; Lee and Ramsey, 2011). As shown in (3a), <j> present in LMK is deleted in ModK, while (3b) illustrates cases in which <j> is spuriously added where no glide was present in LMK.

(3) Yod dropping and orthographical confusion in ModK

	LMK	ModK
a.	<cjʌkin>	<cʌkin> ‘small’
	<cjʌcɛ>	<cʌcɛ> ‘market’
b.	<cʌuL>	<cjʌuL> ‘scales’
	<cuL>	<cjuL> ‘string’
	<c ^h aŋ>	<c ^h jaŋ> ‘boot soles’

(Huh, 1964)

In these accounts, post-affricate yod-dropping is closely linked to the underlying place of articulation of affricates. In LMK, when affricates were dental, the palatal glide contrast was realized as a place-of-articulation contrast through allophonic palatalization (LMK: [ts] vs. [tɕ]). Once affricates shifted to a posterior place of articulation in all contexts, however, the underlying palatal glide no longer had a salient surface exponent (ModK: [tɕ] vs. [tɕ]), rendering the contrast perceptually weak and ultimately leading to its loss.

We can formalize this account within Dispersion Theory (Flemming 2004; Ní Chiosáin et al. 2001) in Optimality-Theoretic terms (Prince and Smolensky 2004). In this framework, constraints regulating paradigmatic contrasts are included: faithfulness constraints favour maximizing the number of contrasts, while markedness constraints require a minimum level of perceptual distinctiveness between contrasting forms. As the number of contrasts decreases, the perceptual distance between the remaining contrasts increases. The constraints relevant to our analysis are defined in (4) and (5) (cf. Flemming, 2004).

(4) MaximizeContrasts: Maximize the number of contrasts

(5) Mindist = n : Contrasting sounds must differ by at least n units along a certain auditory dimension.

MAXIMIZECONTRASTS is a faithfulness constraint favouring larger inventories; in our case, it penalizes candidates that merge the contrast between simplex affricates and affricate plus glide sequences. MINDIST constraints are markedness constraints that impose a minimum perceptual distance along a given auditory dimension. The relevant contrast is most saliently cued by frication noise: posterior affricates exhibit lower-frequency frication than anterior affricates, a difference that can be quantified using spectral center of gravity (COG). In addition, vowel formants at the vocalic onset differ due to the presence of the palatal glide as well as consonant-induced transitions. MINDIST constraints are decomposed into a ranked set of increasingly strict requirements, as shown in (6). We do not formalize these constraints in concrete acoustic terms; instead, we treat them as

cover constraints reflecting a composite of acoustic features that distinguish the relevant contrast. We distinguish two relative distance levels, such that [ts] ~ [tɕj] satisfies MINDIST = 1 but not MINDIST = 2, whereas [tɕ] ~ [tɕj] satisfies neither.

(6) Mindist = 1 >> Mindist = 2 >> Mindist = 3 ...

Note that MINDIST = 1 is evaluated on the basis of specific phonetic realizations and is gradient in nature. Assuming allophonic palatalization, *ceteris paribus*, the more anterior the place of affrication in a non-palatalized context, the more perceptually distinct it will be from its palatalized allophone before /j/. Tableau (7) illustrates the LMK system, in which affricates are underlyingly anterior and undergo allophonic palatalization before /j/. Candidate (7a) preserves the contrast between the simplex affricate and the cluster, satisfying MAXIMIZECONTRASTS, and also meets MINDIST = 1 because the surface forms differ in place of articulation. Candidate (7b), which neutralizes the contrast, violates MAXIMIZECONTRASTS. In ModK, by contrast, affricates are posterior in all environments, rendering the surface contrast between the singleton and the cluster tenuous. Candidate (8a), which preserves the contrast, fails to meet the minimum perceptual distinctiveness requirement and is therefore ruled out, leaving the merged form (8b) as optimal.³

(7) LMK: anterior affricate /ts/ with allophonic palatalization

/ts/ ~ /tsj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
→ a. [ts] ~ [tɕj]			*
b. [ts]		*!	

(8) ModK: posterior affricate /tɕ/

/tɕ/ ~ /tɕj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
a. [tɕ] ~ [tɕj]	*!		*
→ b. [tɕ]		*	

The shift to posterior articulation in ModK and the accompanying post-affricate yod-dropping affected all South Korean dialects, while anterior articulation was retained in the Phyeng'an and Yukjin dialects (Huh 1964; Kwak 2001; Lee 1972 [1961]; Lee and Ramsey 2011). In contemporary Yukjin Korean, the contrast between [ts] and [tɕj] is still maintained, as in /tso/ [tso] 'vinegar' versus /tsjo/ [tɕ(j)o] 'candle' (Kwak 2001). We turn to Phyeng'an in the next section.

3 Place of Articulation and Yod-dropping: Dialect Variation

The proposed correlation between the place of articulation of affricates and their co-occurrence restrictions with /j/ across dialects has been challenged from multiple perspectives. First, a substantial body of articulatory research using static palatography (Anderson et al. 2003; Kim 1999), MRI (Kim 2004), and electropalatography (Baik 2003; Kang and Kochetov 2010; Shin 1997)

³ An alternative analysis relying solely on a syntagmatic restriction against sequences of posterior affricates followed by [j] (*tɕj) would rule out [tɕj] in both LMK and ModK.

shows that Korean affricates in South Korean varieties are not as posterior as traditional descriptions suggest. Rather, they are best characterized as lamino-(denti-)alveolar, with constrictions sometimes extending toward the postalveolar region. These studies report that affricates pattern closely with anterior coronal stops and fricatives, though they may be more posterior than anterior fricatives (Hwang 2003) and, crucially, remain more anterior than the posterior fricative allophone [ɕ] found before a front vocoid. This contrasts with English affricates /tʃ, dʒ/, which are typically described as postalveolar—a characterization supported by electropalatographic and acoustic evidence showing posterior constrictions and frication similar to /ʃ/ (Fletcher 1989). Moreover, in cross-language mapping tasks, English listeners frequently perceive Korean affricates as alveolar stops (Schmidt 2007). Taken together, these findings support the view that Korean affricates are articulatorily more anterior than English postalveolar affricates. This result complicates a straightforward identification of Korean affricates as categorically posterior, and suggest that their interaction with /j/ may require a more nuanced account.

Moreover, both impressionistic and instrumental studies of contemporary Korean dialects report substantial within-dialect variation. For example, (Martin 1992: 28-29) notes that ‘the affricates are palatalized throughout the south,’ but also observes that ‘for many Seoul speakers the palatalization is weak or absent before back unrounded vowels, and in the north the nonpalatalized affricate is frequently heard before all the vowels.’ Similarly, detailed dialectological studies document extensive variation and divergence from traditional pan-dialectal characterizations (Han 2005b; So 2022, 2023, 2024). In Seoul Korean in particular, instrumental studies report systematic age- and gender-based variation, with younger and female speakers producing affricates that are closer in place of articulation to anterior fricatives than those produced by older and male speakers (Kang et al. 2014; Kong and Kang 2021; Kong et al. 2014; Schertz et al. 2015).

Despite disagreement over the precise description of the place of articulation of affricates and the substantial within-dialect variation reported in the literature, it is clear that affricate place differs across dialects. Our earlier acoustic studies directly comparing two Northern Korean dialects spoken in China with Seoul Korean have shown clear dialectal differences broadly in line with traditional descriptions (Kang et al. 2014; Schertz et al. 2015). Chinese Korean participants—speakers of dialects derived from Yukjin and Phyeng’an—produced affricates with an anterior place of articulation comparable to that of anterior fricatives, a result that was replicated in a later study of the same dialects using different participant groups (Schertz et al. 2019). By contrast, Seoul Korean speakers produced affricates that were more posterior than anterior fricatives, despite the age- and gender-based variation observed within this group (Kang et al. 2012; Schertz et al. 2015).

Similar dialectal differences between Northern and Southern Korean dialects have also been reported in studies of the speech of North Korean refugees in South Korea. Kang and Yun (2018) compared affricates produced by North Korean refugees from Yukjin- and Hamkyeng-based dialects with those produced by Seoul Korean speakers and found that affricates were more anterior in North Korean speakers than in Seoul Korean speakers. Jung et al. (2025) reported comparable results in their study of North Korean refugees from across North Korea.

For our purposes, the key takeaway from the phonetic literature is that there is substantial variation in the place of articulation of Korean affricates, and that they are produced at a more anterior place of articulation than English affricates and are certainly not ‘palatal’ in the literal

sense of the term. At the same time, Seoul Korean affricates are more posterior than coronal fricatives, unlike in Northern dialects, where affricates have an anterior place of articulation similar to that of fricatives.

Another challenge to analyses that directly link affricate place of articulation to yod-dropping comes from the observation that historical yod-dropping also applied after coronal fricatives (Kim 1999), as shown in (9). This change occurred during ModK, as evidenced by the interchangeable use of <s> and <sj>, paralleling the orthographic variation observed for affricate + /j/ sequences. Examples of etymological /s/ spelled as <sj> in Late ModK are shown in (10).

(9) Post-fricative yod dropping

LMK			Contemporary Korean		
<sjo>	/sjo/	[ʃjo]	<so>	/so/	‘ox’
<soh>	/soh/	[so]	<so>	/so/	‘swamp’
<sjʌm>	/sjʌm/	[ʃjʌm]	<sʌm>	/sʌm/	‘island’
<sʌm>	/sʌm/	[sʌm]	<sʌm>	/sʌm/	‘stairs’

(Lee and Ramsey 2011)

(10) Spurious <j> in ModK

<sjʌLo>	‘mutually’
<sjepʌn>	‘three times’

(Huh 1964)

Under a view in which yod-dropping applies only after posterior coronal consonants, this pattern would imply that /s/ must also have shifted to a posterior place of articulation similar to that of affricates (So 2024). This account is not very satisfactory, however, given that none of the contemporary dialects of Korean retain the hypothesized posterior place of articulation for fricatives. We return to this point below.

A more serious challenge comes from Phyeng’an Korean, which retains anterior affricates but nonetheless exhibits yod-dropping (Han 2005b; Kwak 2001; So 2022). In fact, yod-dropping in this dialect applies after all coronal consonants. Examples are shown in (11), with Seoul Korean forms provided for comparison. LMK /j/ is lost following affricates (11a) and fricatives (11b), as in Seoul Korean. In (11c), LMK coronal stop + /j/ sequences underwent yod-dropping in Phyeng’an Korean (LMK /tjoh-/ > PK /toh-/), whereas in Seoul Korean, they instead triggered palatalization, as shown in (12), which in turn fed post-sibilant yod-dropping (tj > tɕj > tɕ). Examples in (11d) illustrate yod-dropping following coronal nasals, where Seoul Korean retains the cluster. Finally, the examples in (11e) involve word-initial /Lj/, which is avoided in both dialects, leading to loss of the liquid in Seoul Korean but nasalization and yod-dropping in Phyeng’an Korean.

(11) Loss of post-coronal /j/ in Phyeng’an Korean

	Phyeng’an	Seoul	
a.	[tsak-]	[teak-]	‘small’
	[tsaru]	[teaLu-]	‘sack’
	[tsʌlm-]	[tɕʌLm-]	‘young’
b.	[sʌm]	[sʌm]	‘ilsand’
	[so]	[so]	‘ox’
c.	[tʌpsi]	[tɕʌpsi]	‘plate’
	[toh-]	[teoh-]	‘good’

cf. LMK /tjʌpsi/

cf. LMK /tjoh-/

- | | | | | |
|----|-----------|------------|---------------------------|-----------------------------|
| d. | [jaŋnʌm] | [jaŋnjʌm] | ‘condiment’ | |
| | [siŋnaŋi] | [siŋnjaŋi] | ‘dhole’ | |
| e. | [nʌksa] | [jʌksa] | ‘history’ cf. /LɛLjʌk/ | [nɛrjʌk] ‘past, background’ |
| | [nokim] | [jokim] | ‘charge, fee’ cf. /muLjo/ | [murjo] ‘free of charge’ |
- (Han 2005b)

(12) Stop palatalization/affrication

t, t^h, t’ → tɛ, tɛ^h, tɛ’ / __ i, j

Rather than abandoning the correlation between affricate place of articulation and yod-dropping, one can instead posit multiple yod-dropping processes, with the process in Phyeng’an Korean differing in nature from that found in other dialects. This is precisely the view proposed by Kwak (2001) and Han (2005b), who argue that in Phyeng’an Korean a yod-dropping process affected the palatal glide following all coronals, and that this rule applied first, thereby bleeding palatalization of coronal stops, as illustrated by the forms in (11c). In Seoul Korean and other dialects, by contrast, /j/ triggers coronal stop palatalization, and yod-dropping is a distinct process that arose later in the history of the language. Moreover, in Phyeng’an Korean there is a more general tendency to avoid [j] after all consonants, with yod-dropping and monophthongization conspiring to enforce this restriction. Post-consonantal [j] is avoided by yod-dropping in some non-coronal contexts as well (13a), and also by monophthongization of /jʌ/ to [ɛ] within a morpheme (13b) and, more commonly, in sequences derived by morpheme concatenation and glide formation (13c).

(13) General avoidance of post-consonantal /j/ in Phyeng’an Korean

- | | | | | |
|----|-----------------------|------------------------|-----------------|--------------------------|
| | Phyeng’an | Seoul | | |
| a. | [p ^h opʌm] | [p ^h jopʌm] | ‘leopard’ | |
| b. | [mentʌŋ] | [mjʌncʌŋ] | ‘major’ | (Han 2005b) |
| c. | [tsik ^h ɛ] | [teik ^h jʌ] | ‘to maintain’ | /cik ^h i - ʌ/ |
| | [k’ulle] | [k’illjʌ] | ‘to be dragged’ | /k’illi-ʌ/ |
| | [ts’ikʌte] | [te’ikʌte(j)ʌ] | ‘to be taken’ | /c’ikʌti-ʌ, c’ikʌci-ʌ/ |
- (So 2022)

However, this account cannot explain why yod-dropping affected fricatives as well as affricates in ModK as shown in (9) above. Either we must abandon a direct link between posterior coronal place of articulation and yod-dropping under this more restricted yod-dropping rule—thereby undermining the usefulness of yod-dropping as a diagnostic for affricate place of articulation—or we must accept the less satisfying historical *Duke of York* gambit, in which fricatives shift to a posterior place to trigger yod-dropping and then subsequently return to an anterior place in all dialects. We propose a third possibility: namely, that this restricted yod-dropping proceeded in two stages. First, it affected affricates after their shift to a posterior articulation; subsequently, the yod-dropping rule was generalized to all sibilants, including both affricates and fricatives.

English exhibits a similar process of postconsonantal yod-dropping, and its variation across dialects is instructive. According to Wells (1982: 206–207), English yod-dropping proceeded in three stages. The most conservative dialects—Welsh English, northern varieties of British English, Southern American English, and New England American English—retain /j/, yielding minimal pairs such as *chews* vs. *choose*, *rheum* vs. *room*, and *threw* vs. *through*. **Early Yod Dropping**, which affected London English around the beginning of the eighteenth century, deleted /j/ following posterior coronal consonants (/j, tʃ, ʃ, dʒ, ɹ/) and in /l/-final clusters (14a). **Generalized Yod Dropping** represents the most extreme pattern, with yod deleted in most or all postconsonantal

environments, as found in East Anglia (14c). Other accents occupy intermediate positions (**Later Yod Dropping**), showing variable deletion following all coronal consonants, including alveolars but not non-coronals (14b). This latter pattern is found in General American English, in parts of southern and Midland England, and in Canadian English (Pabst 2023).

(14) English yod dropping

a. Early Yod Dropping:

$$j \rightarrow \emptyset / \left\{ \begin{array}{c} \text{Palatal} \\ r \\ Cl \end{array} \right\} _ : \text{chute, chew, juice, yew, rude, crew, shrew, grew, blue, flew...}$$

b. Later Yod Dropping:

$$j \rightarrow \emptyset / \text{Coronals} _ : \text{lewd, suite, tune, dune, enthusiasm, resume}$$

c. Generalized Yod Dropping

$$j \rightarrow \emptyset / C _ : \text{few, music, cube, Hugh}$$

(Wells 1982)

Note that **Early Yod Dropping** is restricted to environments in which the preceding consonant is post-consonantal /l/ or a palatal or postalveolar segment, the latter two being phonetically most similar to /j/—creating sequences that Wells (1982: 207) describes as ‘intrinsically awkward to pronounce.’ These sequences are also perceptually disadvantaged: palatal and postalveolar consonants require a higher and more fronted tongue-body position, similar to that of /j/, which renders a following /j/ less perceptually distinct from consonant-induced formant transitions. This original yod-dropping pattern was subsequently extended to increasingly general phonological environments through analogical extension, first to all coronal contexts and then to all consonantal contexts.

Had we synchronic access only to dialects of type (14b) or (14c), we would not be able to identify posterior coronal place as a preferred context for yod-dropping. Similarly, the fact that yod-dropping affected both sibilants in Modern Korean does not necessarily entail that the process never differentiated between them. It is entirely possible that yod-dropping initially applied only to affricates, following their shift to a posterior place of articulation, while leaving the fricative context intact. A dispersion-theoretic illustration of this hypothetical stage of yod-dropping is provided in (15), where /j/ is neutralized following underlying posterior affricates (15a) but not following underlying anterior fricatives (15b).

(15) Hypothesized stage of yod dropping in ModK: posterior affricate and anterior fricative

(a)	/tɕ/ ~ /tɕj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
	i. [tɕ] ~ [tɕj]	*!		*
	→ ii. [tɕ]		*	
(b)	/s/ ~ /sj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
	→ i. [s] ~ [sj]			*
	ii. [s]		*!	

This perceptually grounded postlexical pattern may subsequently have been reanalyzed as a phonotactic constraint at the lexical level, as expected under the life cycle of phonological processes (Bermúdez-Otero 2013). Initially, this took the form of a restriction on posterior coronal + /j/ sequences (16a), which was later extended to all coronal obstruents, including anterior stops and

fricatives (16b). Note that stop palatalization also took place around the same time: this process converted coronal stops into affricates before /j/, which in turn fed yod-dropping ($tj > tɕj > tɕ$), resulting in a surface gap of *tj. The two restrictions, *tɕj and *tj, can be unified into a simpler constraint targeting the natural class of coronal obstruents, prohibiting *sj as well, by dropping the subcoronal place restriction in (16a).⁴ While one could alternatively posit a constraint that specifically targets plosives (*tɕj and *tj), such an analysis would be both less phonetically motivated and more stipulative. By contrast, the constraints in (16) prohibit co-occurrences of similar place features and are therefore more natural.

- (16) a. *[POSTERIOR]+J : prohibits a sequence of posterior coronal obstruent and /j/ (*tɕj)
 b. *[CORONAL]+J : prohibits a sequence of coronal obstruent and /j/ (*tɕj, *sj, *tj)

We can now illustrate the change from LMK to ModK using these phonotactic constraints. The tableaux in (17–19) are not intended to model the derivation of specific forms, but rather to capture the relevant phonotactic restrictions, with the relative ranking of phonotactic constraints and FAITHFULNESS constraints adjusted to reflect the observed surface sequences. Note that these constraints operate at the lexical level, prior to allophonic palatalization. Consequently, underlying sequences of an anterior coronal consonant followed by /j/ do not violate (16a), even though post-lexical palatalization yields sequences like /tsj/ [tɕj] and /sj/ [ɕj] in the phonetic output. In (17), all coronal obstruents have an anterior place of articulation and the palatal glide is retained in all contexts, indicating that *[CORONAL] + J must be ranked below FAITHFULNESS. The higher-ranked constraint *[POSTERIOR] + J is satisfied vacuously.

(17) LMK (lexical): anterior affricate /ts/, fricative /s/, and stop /t/

(a)	/tsj/	*[POSTERIOR] + J	FAITHFULNESS	*[CORONAL] + J
	→ i. tsj			*
	ii. ts		*!	
(b)	/sj/	*[POSTERIOR] + J	FAITHFULNESS	*[CORONAL] + J
	→ i. sj			*
	ii. s		*!	
(c)	/tj/	*[POSTERIOR] + J	FAITHFULNESS	*[CORONAL] + J
	→ i. tj			*
	ii. t		*!	

(18) illustrates a hypothetical early stage of Modern Korean in which affricates have shifted to a posterior place of articulation and yod-dropping applies only in affricate contexts, as described by the postlexical process in (15). At this stage, the postlexical pattern is reanalyzed as a categorical phonotactic restriction at the lexical level. This restriction is captured by the constraint *[POSTERIOR] + J, which is ranked above FAITHFULNESS, thereby enforcing yod-dropping following posterior affricates (18a), but not following anterior fricatives (18b). Around the the same time in ModK, coronal stop + /j/ sequences are also eliminated, but for an independent reason: palatalization applies to coronal stops before /j/ (12), feeding yod-dropping and resulting in the loss of surface *tj sequences. The simultaneous loss of both affricate + /j/ and stop + /j/ sequences, to the

⁴ Albright (2002) demonstrates that overgeneralization in language acquisition and change arises because learners favour relatively general rules that are imperfect but apply to a large number of items over highly specific rules that are exceptionless but apply to only a small number of items.

exclusion of fricative + /j/ sequences, creates a ranking paradox. This paradox is ultimately resolved by adopting a more general phonotactic constraint. By promoting *[CORONAL] + J above FAITHFULNESS, the grammar generalizes the restriction from posterior affricates to all coronal obstruents, as shown in (19).

(18) Hypothetical ModK early stage (lexical): posterior affricate /tɕ/

(a)	/tɕj/	*[POSTERIOR] + J	FAITHFULNESS	*[CORONAL] + J
	i. tɕj	*!		*
	→ ii. tɕ		*	
(b)	/sj/	*[POSTERIOR] + J	FAITHFULNESS	*[CORONAL] + J
	→ i. sj			*
	ii. s		*!	
(c)	/tj/	*[POSTERIOR] + J	FAITHFULNESS	*[CORONAL] + J
	i. tj			*
	← ii. t		*!	

(19) ModK (lexical): after extension of phonotactic restriction

(a)	/tɕj/	*[POSTERIOR] + J	*[CORONAL] + J	FAITHFULNESS
	a. tɕj	*!	*	
	→ b. tɕ			*
(b)	/sj/	*[POSTERIOR] + J	*[CORONAL] + J	FAITHFULNESS
	a. sj		*!	
	→ b. s			*
(c)	/tj/	*[POSTERIOR] + J	*[CORONAL] + J	FAITHFULNESS
	a. tj		*!	
	→ b. t			*

The proposed historical development should be evaluated through more detailed quantitative analyses of historical data, a task we leave for future research. Given that the historical evidence for yod-dropping primarily comes from interchangeable yod-ful and yod-less spellings, support for this hypothesis would take the form of more frequent and systematic orthographic variation following affricates than following fricatives. Admittedly, this scenario is highly speculative, and the phonological evidence for a historical shift in affricate place of articulation remains tenuous. With this background in place, we now turn to loanwords in Contemporary Korean. In this domain, coronal + /j/ sequences are reintroduced into the language, and affricates and fricatives pattern differently.

4 Loanwords and the Retreat of Phonotactic Restrictions

As a result of yod-dropping and palatalization, sequences of a coronal stop plus /j/ (tj), a fricative plus /j/ (sj), or an affricate plus /j/ (cɕj) have been eliminated from the ModK lexicon. In Contemporary Korean (c. 1890–present), these restrictions persist in native and Sino-Korean morphemes but are relaxed in morphologically derived environments and loanwords (Y. Kang, 2013). In loanwords, an asymmetry has emerged between affricates and other coronals: ⟨j⟩ is more restricted following affricates than in other coronal contexts. Although there is no direct historical evidence

for differential treatment of posterior affricates and anterior fricatives in post-coronal yod-dropping, an asymmetry becomes evident in the opposite change—the reintroduction of post-coronal yod in loanwords. This provides indirect evidence for a systematic difference in the place of articulation of affricates and fricatives in Contemporary Korean. In this section, we review the relevant evidence—drawn primarily from Y. Kang (2013) and the literature cited therein—and present an Optimality-Theoretic formalization of variation across time, lexical strata, and dialects.

Y. Kang (2013) examined the adaptation of English postalveolar coronal obstruents /tʃ, dʒ, ʃ, ʒ/ in loanwords across three periods of Contemporary Korean: Enlightenment Period Korean (EPK; 1890–1910), 1930s Korean, and Present-Day Korean (PDK). In PDK, sequences of a coronal stop plus /j/ (Tj) and a fricative plus /j/ (Sj) are permitted in loanwords. English /tj/, /dj/, and /ʃj/ are adapted with a palatal glide as /tʰj/, /dj/, and /sj/, respectively, with the latter realized as a posterior fricative [ɕj], as shown in (20a–b). The status of affricate plus /j/ sequences (Cj), however, is less clear: English postalveolar affricates are variably transcribed with or without ⟨j⟩, as illustrated in (20c).

(20) Coronal obstruent + /j/ in English loanwords in PDK

- | | | | | |
|----|----------|---|----------------------|------------------------|
| a. | tuna | → | <thjuna> | |
| | duo | → | <tjuo> | |
| b. | shopping | → | <sjophin> | [ɕjop ^h in] |
| | sharp | → | <sjaphi> | [ɕjap ^h i] |
| c. | choice | → | <choisi> ~ <chjoisi> | |
| | junior | → | <cuniA> ~ <cjuniA> | |

The yod-full transcription following affricates in these loanwords is frequently attested, despite the normative foreign-word convention that explicitly dictates that prevocalic affricates be transliterated as simple affricates, and despite the fact that these glides are neither reliably produced nor perceived (Kang 2006, 2009). At the same time, Lee and Goldrick (2016) report more robust differences in nonce-word production and argue that this pattern reflects incomplete neutralization, suggesting that post-affricate glide transcriptions are not entirely spurious.

Such persistence of post-affricate yod can be attributed to the intermediate place of articulation of Korean affricates: Korean affricates are not as posterior as their English counterparts, and the addition of /j/ serves to more accurately represent the postalveolar characteristics of English affricates (Shin 2008). At the same time, surface phonotactic restrictions prevent yod from surfacing in the phonetic output. Y. Kang (2013) argues that this constitutes a case in which loanwords introduce a covert contrast—post-affricate yod—without overt surface realization, and that native speakers’ orthographic transcriptions can reveal latent sounds that are phonetically unrealized yet psychologically real, as observed by Sapir (1933 [1949]).

Evidence for the asymmetrical adoption of post-sibilant yod can be found from the earliest stage of contact with English in Early Modern Korean (EPK; c. 1890–1910). Recall that in ModK, yod-ful and yod-less spellings were used interchangeably, reflecting the loss of contrast, and this spelling practice continued into EPK. As a result, fricatives and sibilants were variably spelled with spurious ⟨j⟩ (21), and Korean language textbooks and dictionaries published during the EPK period indicate that these ⟨j⟩ segments were not pronounced, serving instead as remnants of archaic spellings (Park 2005). Similarly, in loanwords, ⟨j⟩ spelling was frequently attested following both anterior and posterior sibilants of English (22).

(21) <j> in EPK native words

<saram> ~ <sjaram> ‘person’ [saram]

<c^hΛim> ~ <c^hjΛim> ‘first’ [c^hΛim]

(22) <j> in EPK loanwords

a. /s/ *Sardinia* <saLtijnia>*Massachusetts* <massjac^hjuseschΛL>b. /ʃ/ *Shannon* <sannon> ~ <swænon>*Pasha* <p^hasja>c. /tʃ/ *chartered* <c^hat^hΛti>*cherry* <c^hjeLi>d. /dʒ/ *budget* <pacest^hi>*New Jersey* <nwiu cjeLsi>

However, the distribution of post-sibilant ⟨j⟩ spelling in loanwords was not completely arbitrary. The percentage of yod-ful spelling by English consonants in loanwords is summarized in Table 1. For the posterior fricative /ʃ/, ⟨j⟩ occurred at a much higher rate before a back vowel (70%) than before a front vowel (10%). This is consistent with a more general process in which /j/ frequently deletes before front vowels in other post-consonantal contexts in EPK (23) and, more generally, in Contemporary Korean. In contrast, English /s/ was spelled with ⟨j⟩ at a lower rate, both before a back vowel (16.1%) and a front vowel (25.0%). Similar to /s/, /tʃ/ and /dʒ/ were transcribed with ⟨j⟩ at comparable rates across vowel contexts. Y. Kang (2013) interprets this pattern as evidence that ⟨j⟩ spelling after /ʃ/ is phonologically real, whereas it is not after /s/, /tʃ/, and /dʒ/.

	/s/	/ʃ/	/tʃ/	/dʒ/
Before back vowels	16.1% (n=93)	70% (n=30)	33.3% (n=27)	30.8% (n=65)
Before front vowels	25.0% (n=48)	10% (n=10)	33.3% (n=12)	33.3% (n=48)

Table 1. <j> occurrence rates in English sibilant adaptation in EPK (Y. Kang 2013)

(23) /j/ deletion before front vowels

/kwankje/ [kwanke] ‘relation’

/cihje/ [cihe] ‘wisdom’

(Kim 2000)

By 1937, the spelling reforms had taken effect, and as summarized in Table 2, spurious ⟨j⟩ was almost never found following English anterior sibilants, /s/ (0.8%) or /z/ (0.5%), but occurred frequently after /ʃ/ (75.7%), and remained variable after /tʃ/ (27.1%) and /dʒ/ (23.1%). Han’s (2005) study of speech recordings from the 1930s shows that ⟨sj⟩ was pronounced as a posterior fricative [ɕ], while ⟨c⟩ and ⟨cj⟩ were homophonous, much as in Present-Day Korean. Thus, as in Present-Day Korean, ⟨j⟩ was added in the adaptation of English affricates to signal a covert contrast that is unrealized at the surface.

/s/	/z/	/ʃ/	/tʃ/	/dʒ/
0.8% (n=889)	0.5% (n=145)	75.7% (n=621)	27.1% (n=280)	23.1% (n=337)

Table 2. <j> occurrence rates in English sibilant adaptation in 1937 out of all contexts where ⟨j⟩ spelling was possible, including before non-high front vowels (Y. Kang 2013)

This asymmetry in the adaptation of English postalveolar fricatives and affricates persists in Present-Day Korean. Y. Kang's (2013) Google search of 28 representative loanwords (conducted in July–August 2009) found that ⟨j⟩ occurred in 86.9% of /ʃ/ adaptations, but in only 19.1% of /tʃ/ adaptations and 14.6% of /dʒ/ adaptations. Note that the asymmetrical surface distribution of yod after fricatives and affricates—/j/ tends to be permitted following fricatives but is avoided following affricates—in these Contemporary Korean loanwords parallels the pattern hypothesized for the early stage of yod-dropping in ModK in (15), repeated here as (24).

(24) Contemporary Korean loanwords and Hypothesized stage of ModK native words

(a)	/tɕ/ ~ /tɕj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
	i. [tɕ] ~ [tɕj]	*!		*
	→ ii. [tɕ]		*	
(b)	/s/ ~ /sj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
	→ i. [s] ~ [sj]			*
	ii. [s]		*!	

The crucial difference between ModK and Contemporary Korean is that the palatalization rule that eliminated coronal stop + /j/ sequences in ModK (12) is no longer productive in Contemporary Korean and is restricted to a limited set of morphologically derived contexts, with no pressure to generalize the restriction to all coronals. The EPK data are particularly informative: during this period, yod-ful and yod-less spellings were used interchangeably in both post-affricate and post-fricative contexts. Without a detailed quantitative comparison, one might conclude that fricatives and affricates pattern alike, lacking a contrastive C + palatal sequence. However, closer quantitative analysis reveals that the two behave differently—a pattern precisely predicted by our hypothetical analysis. It is plausible that a similar asymmetry could be revealed by a quantitative analysis of ModK <j> occurrences.

The discussion of loanwords in this section has so far focused on English loanwords in the South Korean variety of Korean. The South Korean normative convention similarly prohibits the use of ⟨j⟩ following affricates in the transliteration of Japanese and Chinese words.⁵ Specifically, Japanese syllabaries with postvocalic /j/ are systematically transliterated with ⟨j⟩ in all consonantal contexts except after affricates, as shown in (25). Similarly, the Chinese transliteration guidelines include a special clause stating that vowels, ja, je, jo, and ju, that follow consonants that are transliterated as affricates should be written without ⟨j⟩: i.e., Chinese [tɕja] and [tɕje] should be transliterated as 자 <ca> and 제 <ce> instead of *자 <cja> and *제 <cje>. This systematic avoidance of post-affricate ⟨j⟩ in the South Korean convention contrasts with the North Korean convention, where ⟨j⟩ is consistently spelled in the adaptation of posterior affricates (Kim 1996; *Oykwukmal cekkipep* 1985). For the Japanese transliteration shown in (25), the corresponding North Korean norm is the same for the purpose of yod transcription, except that posterior affricates in (25c) are written with a glide as 자, 쥬, 조 <cja, cju, cjo>. Similarly, Chinese alveolopalatal affricates are transcribed with ⟨j⟩, as in Chinese *jia* [tɕja] → 자 <cja> and *jiu* [tɕju] → 쥬 <cju>.⁶ Likewise, in English loanwords, affricates are transliterated with ⟨j⟩ before back vowels, but without <j> before

⁵ https://www.korean.go.kr/front/page/pageView.do?page_id=P000124&mn_id=97

⁶ But, the glide is vocalized before /e/ as in Chinese *jie* [tɕje] → 지에 <cie>.

front vowels, as shown in (26a). Similarly, <j> is also allowed following coronal fricatives (26b) and stops (26c).

(25) Normative convention on transliteration of Japanese syllabaries

Japanese		Korean transliteration
a. ギャ ギュ ギョ	[gja gju gjo]	가 교 규 <kja kjo kju>
ニャ ニュ ニョ	[nja nu no]	냐 뇨 뉴 <nja njo nju>
リャ リュ リョ	[rja rju rjo]	랴 료 류 <Lja Ljo Lju>
b. シャ シュ ショ	[ɕa ɕu ɕo]	샤 슈 쇼 <sja sjo sju>
サ シ ス セ ソ	[sa ɕi su se so]	사 시 스 세 소 <sa si si se so>
c. ジャ ジュ ジョ	[(d)za (d)zu (d)zo]	자 주 조 <ca cu co>
ザ ジ ズ ゼ ズ	[(d)za (d)zi (d)zu (d)ze (d)zo]	자 지 즈 제 조 <ca ci ci ce co>

(26) North Korean transliteration of English postalveolar affricates and fricatives

a. Charles	<ɕ ^h jaLsi>
George	<ɕjoci>
b. short	<sjo th i>
sharp	<sja ^h i>
c. due/dew	<tju>
steward	<si th juati>

While normative conventions can be detached from the actual usage patterns of native speakers—and it remains to be seen how accurately these conventions reflect speakers’ intuitions—the systematic difference between the South and North Korean conventions is striking. Note that North Korean standards are based on the Korean spoken in Pyongyang, the capital of North Korea, which lies within the Phyeng’an dialect area. Recall that this is a dialect where affricates retain an anterior place of articulation in contrast to the South Korean dialects. The covariation of place of articulation and post-affricate yod-dropping across the two dialects is precisely what’s predicted by the analysis developed so far. In native words, both North and South Korean varieties prohibit palatal glides following affricates. If anything, the Phyeng’an dialect imposes a stricter restriction on post-consonantal palatal glides in native words than Seoul Korean. Nevertheless, in loanwords, the North Korean variety more readily permits affricate-plus-glide clusters, as well as glides after other coronal consonants. The North Korean loanword pattern is identical to the LMK native words, as illustrated in (27), which contrasts with (24) for the South Korean loanword pattern.

(27) North Korean loanwords and LMK native words

(a)	/ts/ ~ /tsj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
	→ i. [ts] ~ [tsj]			*
	ii. [ts]		*!	
(b)	/s/ ~ /sj/	MINDIST = 1	MAXIMIZECONTRASTS	MINDIST = 2
	→ i. [s] ~ [sj]			*
	ii. [s]		*!	

In the next section, we turn to a production experiment and an interlanguage mapping experiment designed to test the hypothesis that the differential adoption of post-affricate ⟨j⟩ spelling reflects

differences in affricate place of articulation, rather than being a normative artifact without phonetic or phonological reality.

5 Acoustic Characteristics: Production and Perception Experiments

We report on a production study and an interlanguage perception study with speakers of four Korean dialects: two Chinese Korean heritage varieties (Yukjin and Phyeng'an, both with anterior affricates), Seoul Korean, and Toronto Heritage Korean. Data were collected in summer 2011 in Qingdao (Yukjin)⁷, Dandong (Phyeng'an), and Seoul, and in 2012 in Toronto, as part of a larger project. Participant breakdown by group, gender, and age is summarized in Table 3. The Seoul group is divided into older (born before 1970) and younger speakers, while all participants in Qingdao and Dandong are older, and all in Toronto are younger. For Dandong and Seoul, some speakers completed only one of the two tasks; counts for those who completed both are provided in parentheses.

	Dandong: Older (DO)	Qingdao: Older (QO)	Seoul: Older (SO)	Seoul: Younger (SY)	Toronto: Younger (TY)
Female	12 (11)	10	17 (15)	11	10
Male	16 (11)	11	19 (17)	14	10
Year of Birth range	1937~1969	1936~1966	1943~1966	1981~1992	1980~1993

Table 3. Total number of participants by dialect, age, and gender; counts of participants who completed both tasks are given in parentheses

5.1 Production Study

Sibilants produced by the same participants (with the exception of the Toronto speakers) were analyzed in our earlier studies and were found to exhibit significant dialectal differences in affricate place of articulation, both word-initially (Kang et al. 2014) and word-medially (Schertz et al. 2015). Specifically, Chinese Korean speakers' affricates showed an anterior place of articulation similar to that of fricatives, whereas Seoul Korean speakers' affricates were more posterior than fricatives and than those of the Chinese Korean dialects. We therefore hypothesize that Toronto speakers will pattern with Seoul Korean speakers, showing similarly posterior affricates, as they speak varieties of South Korean dialects. At the same time, given the bilingual influence of English, Toronto speakers' affricates may be realized as even more posterior due to equivalence classification with English postalveolar affricates (Flege 1995; Schertz et al. 2019) or alternatively as more anterior in order to further differentiate Korean affricates from their English counterparts (Chang et al. 2011).

In the current study, we analyzed word-initial affricates and fricatives in two words (/cap-a/ 'to hold' and /sal-a/ 'to live') produced by all speakers, both to confirm previously reported dialectal differences and to incorporate new data from Toronto Heritage Korean. The fricative, which is expected to have an anterior place of articulation across all dialects, was included for comparison. In the production task, participants produced each target word once in a sentence frame, three

⁷ The Chinese Korean speakers in Qingdao are recent migrants from the Yanbian Autonomous Region and can be referred to as Yanbian Korean speakers, whose proto-dialect is Yukjin Korean. In earlier work, we called this the Hamkyeong variety because Yukjin is geographically part of Hamkyeong province and shares some phonological features, such as pitch accent. However, Yukjin is generally recognized as a distinct dialect. In this paper, we refer to the dialect groups by their current city of residence.

times in a short phrase, and three times in isolation. Analyses focused on the isolated productions. A total of 123 speakers completed the production task, yielding 733 tokens of affricates and fricatives (123 speakers $\times$ 2 words $\times$ 3 repetitions, minus 5 tokens due to omission or mispronunciation). Frication noise was identified, and the spectral center of gravity (CoG) was calculated over the middle 30 ms of the frication interval after applying a 500 Hz high-pass filter. CoG of frication noise is negatively correlated with the size of the front cavity, and a more posterior place of articulation is indicated by lower CoG values. We therefore predict higher affricate CoG values in Chinese Korean than in Seoul and Toronto Korean, with affricate CoG approximating fricative CoG in Chinese Korean but remaining lower than fricative CoG in Seoul and Toronto Korean.

Boxplots in Figure 1 shows the distribution of frication-noise center of gravity (CoG) values (in Hz) by speaker dialect, age, and gender. The two North Korean dialects (DO, QO) pattern together in showing comparable CoG values for the two sibilant conditions, whereas Seoul Korean and Toronto Heritage Korean show greater divergence, as predicted. Younger Seoul female speakers stand out as exceptions to this generalization, exhibiting comparable distributions for the two sibilants. It is also notable that, although younger Seoul male speakers maintain a contrast between the two sibilants, they overall produce more fronted sibilants—both affricates and fricatives—than their older male counterparts. In particular, their fricatives have CoG values comparable to those of the female speakers, and many of the male participants in this group produced a dental fricative.⁸ This gender- and age-based variation in Seoul Korean affricates has also been observed by Kong and Kang (2020, 2021), who examined acoustic characteristics of spectral peak frequency in sibilant productions from adult speakers born between 1942 and 2009. It is also notable that Toronto Heritage Korean speakers pattern like Older Seoul Korean speakers.

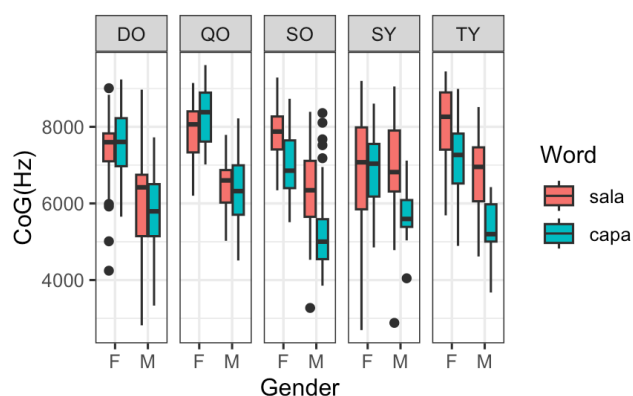


Figure 1. Distributions of CoG (center of gravity) values (in Hz) for the affricate (/cap-a/ ‘to hold’) and the fricative (/sal-a/ ‘to live’) productions, separated by gender and five speaker groups: DO (Old Dandong), QO (Old Qingdao), SO (Older Seoul), SY (Younger Seoul), TY (Young Toronto Heritage Korean)

A linear mixed effects model was built to predict CoG values by fixed effect variables of target words (WORD: capa, sala), dialectal groups (GROUP: DO, QO, SO, SY, TY), and speaker gender

⁸ A survey of attitudes and beliefs about Korean ‘short tongue pronunciation’ found that dental realizations of coronal fricatives—such as [kires’ʌ] > [kireθʌ] ‘that’s what happened’—were more frequently associated with male speakers (Holliday and Kong 2025).

(GENDER: female, male) including combinatory interactions of the three variables. Random intercepts and by-participant random slopes for WORD were considered to account for individual differences in the effect of WORD across listeners. The formula is shown in (28). The model was made using the *lme4* package (Bates et al. 2015). Type II Wald chi-square tests were conducted to evaluate the main effect of the fixed effect variables using the *Anova()* function of the *car* package (Fox and Weisberg 2019). The output is summarized in Table 4. The results show a significant main effect of all three predictors: WORD, GROUP, and GENDER. We also found significant two-way interactions of WORD with GROUP (WORD:GROUP) and with GENDER (WORD:GENDER), and a marginally significant interaction of GROUP with GENDER (GROUP:GENDER). These interactions were followed up with post-hoc tests using the *emmeans* package (Lenth and Piaskowski 2025), and the results are summarized in Table 5.

(28) $\text{lmer}(\text{COG} \sim \text{WORD} * \text{GROUP} * \text{GENDER} + (1 + \text{WORD} | \text{PARTICIPANT}))$

	<i>Chisq</i>	<i>Df</i>	<i>Pr (>Chisq)</i>	
WORD	47.1385	1	<0.0001	***
GROUP	15.0080	4	0.0047	**
GENDER	114.2277	1	<0.0001	***
WORD:GROUP	30.6972	4	<0.0001	***
WORD:GENDER	10.3065	1	0.0013	**
GROUP:GENDER	8.8872	4	0.0640	.
WORD:GROUP:GENDER	4.6846	4	0.3212	

Table 4. Analysis of Deviance Table (Type II Wald chi-square tests) of the regression model in (28)

a. WORD effect (capa-sala) by GROUP

DO	QO	SO	SY	TY
-109 (0.5796)	110 (0.6000)	-973 (<0.0001)***	-567 (<0.0041)**	-1225 (<0.0001)***

b. WORD effect (capa-sala) by GENDER

Female	Male
-264 (0.0432)	-842 (<0.0001)***

c. GENDER effect (female-male) by GROUP

DO	QO	SO	SY	TY
1506 (<0.0001)***	1680 (<0.0001)***	1666 (<0.0001)***	515 (0.0940) .	1566 (<0.0001)***

d. WORD effect (capa-sala) by GROUP * GENDER

	DO	QO	SO	SY	TY
Female	155.6 (0.5924)	395.4 (0.1959)	-900.3 (0.0004)***	52.4 (0.8568)	-1020.6 (0.0011)**
Male	-373.0 (0.1588)	-174.5 (0.5482)	-1046 (<0.0001)***	-1186.8 (<0.0001)***	-1428.7 (<0.0001)***

Table 5. Posthoc tests of WORD effect (capa-sala) within each subgroup of GROUP (a), GENDER (b), and GROUP*GENDER (d), and posthoc test of GENDER effect (female – male) within each GROUP (c): estimated effect size and p-values (in parentheses) with kenward-roger degree of freedom method are shown

The significant interaction of WORD and GROUP (WORD:GROUP), which is the primary test of our interest, arises from the fact that the Chinese dialects show no significant difference in CoG by WORD, whereas the other three groups do (Table 5a). This result confirms observations from the literature that the northern dialects of Korean—particularly the Yukjin and Phyeng'an varieties—have anterior affricates, while most other Korean dialects, including Seoul Korean, have posterior

affricates. We find that Toronto Heritage Korean pattern with Seoul Korean as predicted. We also found a significant interaction of WORD and GENDER (WORD:GENDER) reflecting the fact that affricates are generally more fronted and closer to fricatives in female speech than in male speech (Table 5b). This gender difference is particularly notable in the two Chinese dialect groups and the younger Seoul group, where female speakers produce both affricates and fricatives with comparable CoG values, whereas male speakers in the same groups show a difference between words, with higher CoG values (i.e., more anterior realizations) for fricatives than for affricates. The significant interaction of GROUP and GENDER (GROUP:GENDER) reflects the fact that gender differences do not reach significance in all groups (Table 5c). As expected based on physiological differences in vocal tract size, CoG values are generally higher for female than for male speakers; however, this difference is marginally significant for younger Seoul speakers (also see Kong and Kang 2020). Although the three-way interaction did not reach significance, the presence of significant two-way interactions motivated further examination of the effect of WORD within each GROUP * GENDER subgroups (Table 5d). These results confirm the exploratory observations from the figures: none of the Chinese subgroups show a significant effect of WORD on CoG, whereas all Seoul and Toronto groups—except younger Seoul females—show significantly higher CoG values for fricatives than for affricates.

5.2 Interlanguage Mapping Experiment

Having confirmed dialectal differences in the acoustic realization of affricate place of articulation, we now turn to the interlanguage perceptual mapping experiment. As auditory input, we used Japanese stimuli rather than English or Chinese, since some of the Korean dialects under investigation are in intense contact with the latter two languages; speakers' bilingual knowledge of those languages, as well as their awareness of correspondences with existing loanwords, could therefore influence interlanguage mapping. Although some participants reported knowledge of Japanese, they constituted only a small minority.

Japanese voiced affricates were chosen as stimuli because they contrast in place of articulation: alveolar ㇰ [dza] versus alveolo-palatal ㇱ [dʒa]. In the experiment, participants heard Japanese nonce words [dzára] or [dʒára] (with initial pitch accent) and selected between two Korean monosyllables, <ㄷ> (<ca>) and <ㄷㅈ> (<cja>), that best matched the first syllable. We predict that, for speakers and dialects of Korean in which affricates have an anterior place of articulation, the anterior affricate will be mapped onto the Korean affricate (ㇰ [dza] → ㄷ <ca>), whereas the posterior affricate will be mapped onto a Korean affricate plus palatal glide sequence (ㇱ [dʒa] → ㄷㅈ <cja>). By contrast, in dialects with more posterior affricates, native affricates are more similar to the posterior Japanese affricates, reducing the need to add a palatal glide to approximate the input; moreover, even when a palatal glide is added, it is not perceptually distinctive in the Korean surface output. As a result, the two Japanese inputs are less likely to be distinguished in interlanguage perceptual mapping.

The stimuli were recorded by three young male Japanese speakers, and five tokens of each word were selected from each speaker, yielding a total of 30 trials (=5 tokens × 2 words × 3 speakers). 127 listeners completed the task, and a total of 3810 responses are analyzed (=127 listeners × 30 trials). An acoustic analysis of the stimuli, comparable to that conducted for the Korean data,

confirmed that all three speakers consistently distinguish the two affricate places of articulation, as shown in Figure 2. The experiment was implemented in Praat.

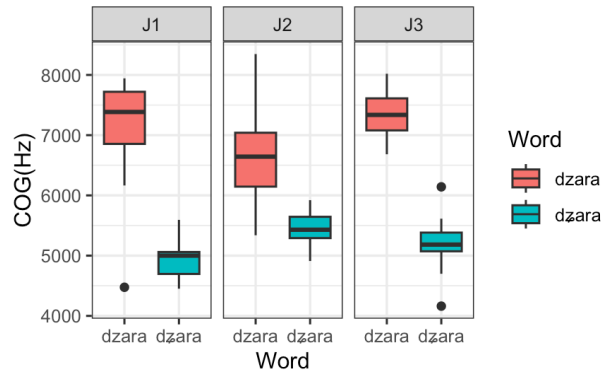


Figure 2. Distributions of CoG (center of gravity) values (in Hz) for the anterior and posterior affricate productions, separated by three Japanese speakers (J1, J2, and J3)

Figure 3 summarizes the results by showing the proportion of yod-ful responses across conditions. We focus on differences in responses as a function of the input stimuli. In the two Chinese Korean dialect groups (DO, QO), there is a substantial difference in yod-ful response rates depending on the place of articulation of the input affricate. The older Seoul Korean group (SO) and the Toronto group (TY) show minimal differences in response rates between the input stimuli, whereas the younger Seoul Korean group (SY) shows a distinction comparable to that observed in the Chinese dialect groups.

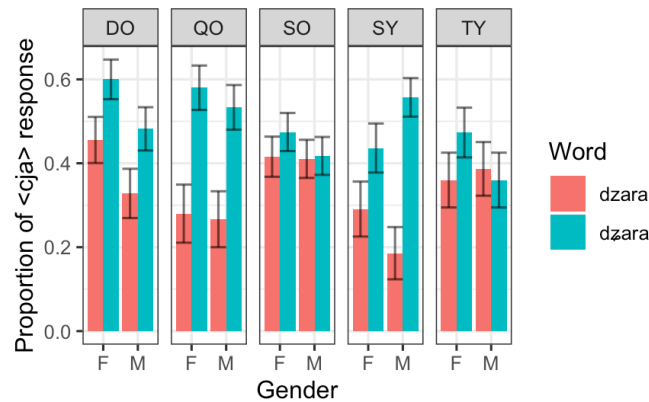


Figure 3. Proportion of yod-ful response <cja> separated by Japanese input word ([dzara] vs. [dzara]), gender, and five speaker groups: DO (Older Dandong), QO (Older Qingdao), SO (Older Seoul), SY (Younger Seoul), TY (Younger Toronto Heritage Korean)

To confirm the observed patterns, we made a mixed effects logistic regression model as shown in (29) that predicts the responses (RESPONSE: ㅈ<ca> and ㅈㅅ<cja>) by fixed variables of input words (WORD: dzara and dzara), dialectal groups (GROUP: DO, QO, SO, SY, TY), and participant gender (GENDER: female, male) including combinatory interactions of the three variables. Random intercepts and by-participant random slopes for WORD were included to capture individual differences in the effect of input words across listeners. A random intercept for stimulus speakers (STIM_SPEAKER) was also included to consider variability in baseline response tendencies across

different speakers. The *Anova()* test was performed to test the main effect of the fixed effect variables. Significant interactions were probed using *emmeans()*.

```
(29) glmer(RESPONSE~WORD*GROUP*GENDER+(1|WORD|PARTICIPANT)+(1|STIM_SPEAKER), family='binomial',
      control=glmerControl(optimizer='bobyqa', optCtrl=list(maxfun=100000)))
```

The results in Table 6 show a significant main effect of WORD, and a significant two-way interaction of WORD and GROUP (WORD: GROUP), and a marginally significant three-way interaction of WORD, GROUP, and GENDER (WORD:GROUP:GENDER). This means that overall, posterior affricates are more likely to induce a yod-ful response, but this effect depended on the dialect and the gender of the listener. Post-hoc comparisons by dialect group in Table 7a show that the effect of the input stimulus is significant for the Chinese dialect groups and the younger Seoul Korean group, whereas the older Seoul Korean group and the Toronto Heritage group show no significant difference between the two input words. The marginal three-way interaction in Table 7b reflects a weak effect of WORD among female Toronto Heritage speakers, with no corresponding effect among male speakers, as well as a substantially stronger effect of WORD among younger Seoul Korean male speakers than among their female counterparts.

	<i>Chisq</i>	<i>Df</i>	<i>Pr (>Chisq)</i>	
WORD	53.0548	1	<0.0001	***
GROUP	4.7875	4	0.3098	
GENDER	1.6093	1	0.2046	
WORD:GROUP	31.4078	4	<0.0001	***
WORD:GENDER	0.0012	1	0.9723	
GROUP:GENDER	4.0075	4	0.4050	
WORD:GROUP:GENDER	8.3278	4	0.0803	.

Table 6. Analysis of Deviance Table (Type II Wald chi-square tests) of the regression model in (29)

a. WORD effect (dzara – dzara) by GROUP

	DO	QO	SO	SY	TY
	-0.723 (0.0014)**	-1.604 (<0.0001)***	-0.227 (0.2289)	-1.464 (<0.0001)***	-0.262 (0.2991)

b. WORD effect (dzara – dzara) by GROUP * GENDER

	DO	QO	SO	SY	TY
Female	-0.652 (0.0462)*	-1.760 (<0.0001)***	-0.350 (0.1990)	-0.892 (0.0117)*	-0.596 (0.0944) .
Male	-0.794 (0.0116)*	-1.448 (<0.0001)***	-0.104 (0.6886)	-2.036 (<0.0001)***	0.073 (0.8387)

Table 7. Posthoc tests of WORD effect (dzara – dzara) within each subgroup of GROUP (a) and GROUP*GENDER (b): estimated effect size and p-values (in parentheses) with kenward-roger degree of freedom method are shown

These results are largely consistent with our prediction that the contrastive use of a post-affricate palatal glide is a function of the anterior place of articulation of Korean affricates. Groups with anterior affricates—as indicated by the lack of a CoG difference between affricates and fricatives in their Korean productions—use <j> contrastively in the interlanguage mapping task. The only apparent exception to this correspondence is the younger Seoul male group, which shows significantly more posterior CoG values for affricates than for fricatives, yet nevertheless uses <j> contrastively. This pattern can be understood in light of the fact that younger Seoul male speakers' sibilants are overall highly fronted: although affricates are more fronted in younger speakers' speech than in that of older Seoul speakers of either gender, their fricatives are unexpectedly

fronted to an even greater degree, making affricates appear relatively posterior within this group. Thus, the response patterns observed in the cross-language mapping task are consistent with the interpretation that affricates are undergoing fronting in younger Seoul Korean speakers, for both genders.

6 Discussion and Conclusion

This study has examined the relationship between affricate place of articulation and the behavior of the post-affricate palatal glide in Korean, bringing together evidence from acoustic production, loanword orthography, and interlanguage perception. Our results provide converging support for a systematic correlation between affricate place of articulation and the availability of contrastive <j>, and they demonstrate that this relationship is both dialect-sensitive and synchronically active. At a theoretical level, we provided a formal account of the correlation between affricate place of articulation and yod dropping. While native Korean phonotactics categorically prohibits post-affricate palatal glides, this restriction masks an underlying asymmetry between affricates and fricatives that originates in differences in place of articulation. Because native morpheme structure constraints are largely fossilized from earlier stages of the language, they do not transparently reflect ongoing phonetic or phonological change. Loanwords, by contrast, introduce novel segmental configurations and impose new pressures—most notably increased faithfulness demands and a drive to maximize perceptual contrasts—that can partially override inherited phonotactic constraints. In doing so, loanwords expose asymmetries that remain invisible in the native lexicon.

Our analysis of loanword transcription conventions shows that affricates and fricatives behave differently once these new pressures are introduced, and we argue that this difference is grounded in place of articulation. Dialects with anterior affricates are more likely to employ <j> contrastively following affricates, while dialects with more posterior affricates show reduced or absent contrastiveness of the palatal glide. Importantly, this pattern aligns closely with independent acoustic evidence from Korean production data, where dialects differ in the relative CoG values of affricates and fricatives.

The perceptual consequences of these production differences were further demonstrated in the naïve interlanguage mapping task. Speakers were asked to map Japanese anterior and posterior affricates onto Korean affricates with or without <j>, and the resulting response patterns largely mirror the production-based typology. Dialect groups with anterior affricates reliably distinguished the two Japanese inputs by using <j> contrastively, whereas groups with posterior affricates showed reduced differentiation. These findings support the hypothesis that <j> usage in loanword adaptation and interlanguage mapping reflects the perceived place of articulation of the affricate, rather than an abstract or orthography-driven convention.

One notable exception—namely, younger Seoul male speakers—turns out to be informative rather than problematic. Although this group shows a relative posteriority of affricates compared to fricatives in within-group acoustic comparisons, their sibilants are overall highly fronted relative to those of older male speakers. As a result, their interlanguage mapping behavior is consistent with the broader interpretation that affricates are undergoing fronting in younger Seoul Korean, for both genders. This pattern reinforces the view that the perceptual mapping task is sensitive to gradient phonetic properties of the speakers' native categories, rather than to categorical phonological labels.

Methodologically, this study highlights the value of detailed quantitative analysis of orthographic data as a window into phonological structure. Orthography—especially in loanwords—can encode subtle contrasts that are otherwise neutralized in native phonotactics, and when analyzed systematically, it can reveal latent asymmetries in the phonological system. Our findings suggest that further large-scale investigations of loanword usage in North Korean dialect varieties, as well as in diachronically stratified Modern Korean texts, may provide crucial evidence for resolving long-standing questions about the place of articulation of Korean sibilants and their diachronic development.

In sum, by integrating production, perception, and orthographic evidence across dialects, this paper shows that affricate place of articulation plays a central role in shaping both synchronic variation and cross-linguistic mapping patterns in Korean. More broadly, it demonstrates how loanwords and interlanguage perception can serve as powerful diagnostic tools for uncovering phonological contrasts that are obscured by inherited morpheme structure constraints.

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