Assibilation or analogy?: Reconsideration of Korean noun stem-endings[*]

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This paper discusses two approaches to the nominal stem-endings in Korean inflection including loanwords: one is the assibilation approach, represented by H. Kim (2001) and the other is the analogy approach, represented by Albright (2002 *et sequel*) and Y. Kang (2003b). I contend that the assibilation approach is deficient in handling its underapplication to the non-nominal categories such as verb. More specifically, the assibilation approach is unable to clearly explain why spirantization (s-assibilation) applies neither to derivative nouns nor to non-nominal items in its entirety. By contrast, the analogy approach is able to overcome difficulties involved with the assibilation position. What is crucial to the analogy approach is that the nominal bases end with t rather than s. Evidence of t-ending bases is garnered from the base selection criteria, disparities between t-ending and s-ending inputs in loanwords. Unconventionally, I dare to contend that normative rules via orthography intervene as part of paradigm extension, alongside semantic conditioning and token/type frequency.

Keywords: inflection, assibilation, analogy, base, affrication, spirantization, paradigm extension, orthography, token/type frequency

1. Introduction

When it comes to Korean nominal inflection, two observations have captivated our attention. First, multiple-paradigms arise, as explored in previous literature (K. Ko 1989, Kenstowicz 1996, Y. Kang 2003b, Albright 2008 and many others).[1]

(1)   Multiple-paradigms of /pʰatʰ/ 'red bean'
          unmarked   nom[2]   acc   dat/loc
          a. pʰat   pʰatʧʰ-i   pʰatʰ-il   pʰatʰ-e
          b. pʰat   pʰatʧʰ-i   pʰatʧʰ-il   pʰatʰ-e
          c. pʰat   pʰatʧʰ-i   pʰatʧʰ-il   pʰatʧʰ-e
          d. pʰat   pʰas-i   pʰatʧʰ-il   pʰatʧʰ-e
          e. pʰat   pʰas-i   pʰas-il   pʰatʧʰ-e
          f. pʰat   pʰas-i   pʰas-il   pʰas-e

I intuit that the six types of paradigms above seem to arise from stem alternations between t and ʧʰ, t and s and t and tʰ. Alternations in (1a), (1b), (1d) and (1e) are not uniform, but they are leveled in (1c) and (1f), aside from unmarked forms. As to s- and ʧʰ-ending stems, phonological assibilation seems to be responsible for the alternations, considering that the coronal stop t shifts into s or ʧʰ, rather than other way around. The surmise that assibilation creates the alternations is apparently further solidified from the loanword paradigms in (2), as noted by Y. Kang (2003a, b), Davis and H. Kang (2006) and J. Jun and J. Lee (2007) among others:

(2)   unmarked   nom   acc   dat/loc
          pet   pet   pes-i   pes-il   pes-e

[1] To focus on the alternations between coronal stops and sibilants, and to alleviate irrelevant distractions, this paper adheres to the principle of broad phonetic transcription, ignoring the allophonic palatalization s → ʃ before front high vocoids such as [pasi] instead of [paʃi] 'field, nominative', and intervocalic voicing of stop consonants such as [kopi] instead of [kobi] 'crisis'. Also unreleased articulation at the syllable-final stops will not be spelled out as being conceived beyond the concern of this paper.

[2] In this paper, the following abbreviations will be used: nom=nominative, acc=accusative, dat=dative, loc=locative.

David   teipit   teipi**s**-i   teipi**s**-i̵l   teipi**s**-e

The emergence of s-ending amid the loanword adaptation has churned out plenty of proposals such as the morphophonemic analysis offered by Y. Kang (2003a) and lexicalized s-ending proposed by Davis and H. Kang (2006) and H. Kim (2009). In this paper, I am going to show that for the proper explanation for Korean nominal paradigms, it is necessary to broaden our perspective from noun paradigms as such to the whole picture of Korean lexicon and grammar. In other words, we must consider not only nominal but also verbal, adjectival and adverbial morphology.

Another challenge is whether the surge of multiple paradigms, as exemplified in (1), can be viewed as paradigm uniformity, as contended by Kenstowicz (1996), E. Han (2002), Davis and H. Kang (2006), or conversely, as paradigm extension, as suggested by Albright (2008). In this paper, supposing that the t-ending base is privileged to control the alternations with s, ʧʰ, tʰ and rarely ʧ, I would like to advocate the latter view of paradigm extension.

This paper is organized as follows: section 2 explores the assibilation approach and tries to uncover what brings the attempt to be doomed to be abandoned. To be specific, the analysis based on assibilation in front of high vocoids is inconsistent with the observation that s-assibilation takes place exclusively to nominal inflection before i, ruled out in front of a high vowel i̵ in non-nominal categories and entirely disallowed in nominal derivations. Section 3 addresses the analogy approach, trying to reveal that the hypothesis of t-ending bases is consistent with what is truly happening to Korean morphology. It will be shown that the analogy approach works when it cooperates with intervention of the normative orthography as well as token/type frequency or semantic property of relevant lexical items. Section 4 concludes this paper.

2. The assibilation approach

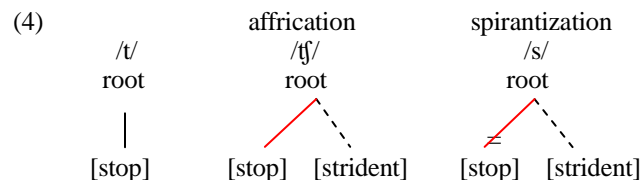### 2.1 Definition of assibilation: a cross-linguistic perspective

In general, phonological assibilation takes place as a process whereby coronal stops t, d become either sibilant affricates ts, ʤ, ʧ, ʤ, or sibilant fricatives z, ʃ, ʒ before high vocoids. Here is the listed illustration from a cross-linguistic perspective:

(3)   a. spirantization   t → s / ___i (Finnish, Kiparsky 1973)
       halut-i   [halusi] 'wanted'   vs.   [halut-a] 'to want'
       vete   [vesi] 'water'

       b. affrication   t→ ts / ___j (German, Hall 2004)
       Nation   [natsjoːn] 'nation'   vs.   nativ [natiːf] 'native'
       Adoption [adɔptsjoːn] 'adoption'   adoptieren [adɔptiːʀən] 'to adopt'

       c. (i) affrication   t→ ts /___u   (ii) palatalization   t → ʧ / ___ +i
                                             (Japanese, Shibatani 1990)
       ta[ts]-u (present) 'to stand'   vs.   ta[ʧ]-i-mas-u (polite present)
       ta[t]-e (imperative)   ta[t]-oo (cohort)
       ta[t]-a-nai (negative)

As seen in (3), what has been identified as assibilation reveals the following properties. First of all, assibilation ramifies into spirantization (3a), affrication (3b, 3ci) and palatalization (3cii). Conversely, the variegated processes pattern together in that the resulting coronal obstruents are sibilant consonants all the time. Phonetically, as observed by Clements (1999) and H. Kim (2001), the sibilant sounds are created by relatively strong turbulence of airstream, amid severe friction resulting from the narrow grooved constriction. That phonetic property

explains why conditioning context involves a set of high vocoids such as i, j, y, u and w. Interestingly, however, previous literature (Kirchner 1998, Clements 1999, H. Kim 2001, Hall 2004) has kept an eye exclusively on the high front vowel or glide. Recall that assibilation produces high-pitched sounds created by articulatory turbulence of airstream, which is a matter of vertical rather than horizontal trajectory of tongue movement. This particular kind of sounds is not possible without a narrow stricture, which is not the case with mid or low vowels. Meanwhile, H. Kim (2001) includes Polish vowels ε, e and a as triggers of assibilation. However, that position is inconsistent with her definition that assibilation has the property of creation of sibilants from stops, resulting in a brief period of turbulence. In this paper, adhering to the definition of assibilation, non-high vowels are excluded from the inventory of legitimate triggers of the phonological process.[3] This idea is further supported in the wake of the phonetic experiment by Hall et al. (2005). Assibilation turns out to be preferred by glides than vowels. He attributes the asymmetry to the fact that glides tend to approximate closer than vowels to the hard palate and consequently, produce more turbulence than vowels.

  Concerning feature representation, I adopt the strident stop model of affricate (Clements 1999). Under the model, affrication means addition of a privative feature [strident], while spirantization means deletion of another privative feature [stop], concomitant addition of [strident], as depicted in (4).

(4)   affrication   spirantization
        /t/   /ʧ/   /s/
       root   root   root

        | ╱   ╲   ╱   ╲

     [stop]   [stop] [strident]   [stop] [strident]

2.2 Assibilation and palatalization

Korean has been described as having two separate types of palatalization (B. Lee 1973, Iverson and Wheeler 1988, E. Han 1994, S. Hong 1997 and others). Lexical palatalization (5a) applies in the context of derived environments, while postlexcial palatalization (5b) occurs across the board, regardless of tauto- or hetero-morphemic context:

(5) a. Lexical palatalization: derived environment
        t^h → $ʧ^{rh}$ / ___ + i

    kat^h-i [kaʧ^{h}i] 'together'   vs.   t^{h}ik'ɨl [t^{h}ik'ɨl] 'dust'
    put^h-i-ta [puʧ^{h}ita] 'to attach'   vs.   mati [mati] 'knot (nominative)'

    b. Postlexcial palatalization: across the board
    s,n,l → ʃ, ɲ,ʎ/ ____ i,y

    sikan [ʃigan] 'time'   vs.   salam [saram] 'human'
    ani [aɲi] 'no'   vs.   anε [anε] 'wife'
    pilljə [piʎʎjə] 'to borrow'   vs.   hollo [hollo] 'alone'

Postlexical palatalization is also observed in loanword adaptation or second language acquisition, as cited in (6) from Eckman et al. (2012).

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[3] For that reason, the historical sound change of spirantization and affrication, called the Second High German Consonant Shift, should be excluded from the domain of assibilation. By this sound change (occurred in the 4th through 6th century), the full set of Old High German stops underwent a context-free process, e.g., [ts] in Zwei 'two', Zehe 'toe', and [s] in essen 'eat', dass 'that'. Notice that assibilation takes place exclusively to coronal stops, unlike the Second High German Consonant Shift.

(6) Hypercorrection by Korean speakers
　　　mashing　→ [mɛsiŋ]　　　shin → [sin]
　　　bushy　　→ [pusi]　　　she → [si]

The rise of hypercorrection in (6) implies that Korean speakers unconsciously palatalize s into postalveolar [ʃ]. As they learn English, they recognize that their pronunciation is being stigmatized. Thus, they consciously try to rectify their [ʃ] into [s]. This would have never happened unless palatalization existed as a psychological entity for them. Additionally, on the status of palatalization, H. Kim (2012: 68) suggests a new perspective. Through an acoustic analysis, she reports that Korean palatalization results from coarticulation of a consonant with a following i rather than via a phonological process, whereby the place of articulation of a consonant moves back to palato-alveolar region. Indeed, her experimental result is consistent with Kiparsky's (1993) and supports the split of palatalization and assibilation. The separation of palatalization and assibilation is one of the pivotal points in this paper.

　　The breakdown of the assibilation listed in (3) is also grounded on the cross linguistic observations. Palatalization tends to be conditioned by the following front vowels, whereas assibilation takes place in front of high vowels.[4] Compelling evidence also exists in Japanese phonology. As given in (3c), in Japanese, both targets and contexts of assibilation and palatalization are not the same. Assibilation is triggered by back high vowel u and t is the single target, while palatalization affects the entire coronal obstruents, conditioned by high vocoids i and j. On the basis of discussion above, it needs to formulate phonological assibilation and palatalization in Korean as (7) and (8).

(7) Assibilation
　　　t, t^h → tʃ, $tʃ^h$,s / ____+high vocoids (i, ɨ, j)

What I mean by the formulation on assibilation (7) is that coronal stops t and t^h undergo one of two operations before high vocoids. In accordance with feature representation made explicit in (4), one option is affrication: addition of feature [strident], thereby they shift to an affricate consonant tʃ or $tʃ^h$. The other is spirantization: deletion of feature [stop] and addition of [strident], thereby they convert into a sibilant s. One thing noteworthy is that assimilation formulated in (7) replaces the existing lexical palatalization, as discussed in (5a), and then palatalization in Korean confines to indicate postlexical palatalization, which applies across the board. In this paper, Korean palatalization refers to the mapping relation as follows

(8) Palatalization
　　　t, t^h, s, n,l → t^j, t^{hj}, ʃ, ɲ, ʎ[5]/____high front vocoids

Again, it is mandatory to notice our characterization that assibilation happens through the vertical dimension, while palatalization is invoked in the horizontal dimension of tongue movement.

2.3 Problems with assibilation analysis

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[4] I think that the absence of back high vowel [u] triggering assibilation in Korean is an accidental gap. Notice that no Korean inflectional and derivational affixes begin with /u/. For the matter of the appearances of non-assibilated output in front of /ɨ/ in non-nominal categories, I will be back in section 3.1.

[5] To make explicit the idea that through the palatalization, Korean coronals seldom shift in their places of articulation, instead of symbols ʃ, ɲ, ʎ, I suspect that symbols s^j, n^j, l^j are more suitable, as the case with Russian. In this sense, stops t, t^h realize as t^j, t^{hj}, and then ultimately, manifest themselves as tʃ, $tʃ^h$ via assibilation. However, for the sake of exposition, the conventional symbols will stay, and t-, t^h- palatalization will not be our concern any more.

Thus far, I have discussed the phonological assibilation and stressed the necessity to separate assibilation from palatalization. It goes without saying that I started the discussion with an intention to ascertain the possibility that the availability of multiple paradigms as shown in (1) can be illuminated from the viewpoint of assibilation. Now, it is time to examine the feasibility of applying assibilation analysis to specific morphological alternations. Let us start from the paradigms of nominal inflection, as given in (9):

(9) Nominal inflection

separate	nominative	accusative	
a. [tikɨt]	[tikɨtʃi]/[tikɨsi]	[tikɨtɨl]/ [tikɨtʃɨl]/ [tikɨsɨl]	'Korean alphabet ⊏'
b. [nat]	[natʃʰi]/ [nasi]	[natʰɨl]/ [natʃʰɨl]/[nasɨl]	'piece'
c. [nat]	[natʃi]/ [nasi]	[natʃɨl]/[nasɨl]	'day'
d. [nat]	[natʃʰi]/ [nasi]	[natʃʰɨl], [nasɨl]	'face'
e. [nat]	[nasi]	[nasɨl]	'sickle'

The assibilation approach to nominal inflection seems to work well for the emergence of multiple paradigms, except for (9e), wherein the doublet of s- and tʃ/tʃʰ-ending stems can be couched within the assibilation setting. Fitting in with machinery of phonological assibilation (7), realization of s and tʃ/tʃʰ in front of high vowels i and ɨ is attributable to assibilation.[6] However, the assibilation approach meets insurmountable difficulties with remaining morphological processes. First, unlike nominal inflection, with verb and adjective, assibilation takes place exclusively in front of front vowels, ruling non-front high vowels out, as illustrated in (10).

(10)   Verbal/adjectival inflection
    a.   __ i: assibilation
        putʰ-i-ta   [putʃʰita] 'to attach, causative'
        kat-hi-ta   [katʃʰita] 'to be entrapped, passive'

    b.   __ɨ: no assibilation
        putʰ-ɨni   [putʰɨni] *[putʃʰɨni] 'to attach'
        matʰ-ɨni   [matʰɨni] *[matʃʰɨni] 'to takeover'
        katʰ-ɨni   [katʰɨn] *[katʃʰɨni] 'the same'

If the assibilation takes places whenever the structural description given in (7) is met, as is true with the nominal inflection in (9), the process ought to apply whenever coronal obstruent stops posit before high vowels. However, as disclaimed by (10b), assibilation never takes place before a high vowel ɨ. Another challenge to the assibilation analysis is found in derivatives from verbs, as displayed in (11):

(11)   Derivation
    verb to noun   /hɛtot-i/   [hɛtotʃi] *[hɛtosi] 'sunrise'
    causative verb   /putʰ-i-ta/   [putʃʰita] *[pusita] 'to attach-
                                                              causative'
    verb to adverb   /katʰ-i/   [katʃʰi] *[kasi] 'together'

If assibilation formulated in (7) is truly responsible for the emergence of coronal sibilants, there is no explaining that instead of multiple paradigmatic alternations as witnessed in (9), in (11) only affrication occurs, bypassing spirantization. The upshot is that the assibilation approach meets a gridlock in describing why spirantization underapplies to verbal and adjectival inflection as well as the derivational morphology from verb to other categories.

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[6] Concerning the issues of spirantization-only in (9e), and the underapplication of assibilation, e.g., tikɨtʰɨl in (9a) and natʰɨl in (9b), I will return in section 3.4.

3. The analogy approach

3.1 Setting up a base

As discussed in section 2, when it comes to assibilation of coronal stops in Korean, nominal inflection stands out among Korean morphological processes, considering that except for nominal inflection, any other types of inflection, derivation and compounding resist either affrication or spirantization. To ensure greater clarification, let us sketch the array of Korean morphology related to our concern.

(12) Affrication
  a. Illustration

	nominal	non-nominal
inflection	natʰ-i [natʃʰi] 'one'	putʰ-i-ta [putʃʰita] 'to attach, causative'
derivation	hɛtot-i [hɛtotʃi] 'sunrise'	katʰ-i [katʃʰi] 'together'
compound	patʰ#ilaŋ [patilaŋ] 'field ridge'	---

  b. Application or not

	inflection	derivation	compound
nominal	√	√	No
non-nominal	√	√	---

As noted in the illustration and check-marked table in (12), with the exception that compounding is disobedient to affrication, Korean morphology proves to be lenient to affrication.[7] Next, let us examine spirantization.

(13) Spirantization
  a. Illustration

	nominal	non-nominal
inflection	natʰ- [nasi] 'one'	/putʰ-i-ta/ *[pusita] 'to attach, causative'
derivation	hɛtot-i *[hɛtosi] 'sunrise'	/katʰ-i/ *[kasi] 'together'
compound	patʰ#ilaŋ *[pasilaŋ] 'field ridge'	---

  b. Application or not

	inflection	derivation	compound
nominal	√	No	No
non-nominal	No	No	---

Contrary to affrication, Korean morphology is ungenerous to spirantization. Nominal inflection exclusively tolerates it, while remaining morphology disobeys the phonological operation. All in all, nominal inflection is distinct from other morphological processes in terms of compliance with phonological assibilation before high front vowel i.

   With this being the case, the key observation on asymmetry between nominal inflection and other morphological processes gives a clue to extricate ourselves from difficulties met by the assibilation approach. Our immediate question is what would be the morphological property that distinguishes nominal inflection from others. The answer is that noun stems embedded within inflected forms are able to stand alone without the support of affixes. This observation is reminiscent of Transderivational Identity (TDI) (Benua 1997). This version of paradigm uniformity is differentiated from Uniform Exponence (EP) proposed by Kenstowicz (1996), in that TDI demands the base of morphology, which controls the derivative forms, but UE does not. The conformity to the base is a constraint

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[7] The absence of non-nominal compounds is believed to be an accidental gap in that aside from noun, Korean compounds lack those having coronal stops placed at the relevant context.

given to nouns, which is not demanded for other categories to obey.

Then, our immediate concern here is to decide the bases among the members of inflectional paradigms. My contention is that unaffixed forms ending with unreleased t constitute bases in Korean inflectional morphology. The hypothesis in favor of the unaffixed form base makes sense in the following grounds: First, in the discussion of a labial obstruent p as in kaps 'price', the alternation kap~kapi~kapɨl, instead of conservative kap~kapsi~kapsɨl, and a velar obstruent k as in talk 'chicken', tak~taki~ takɨl, instead of tak~talki~talkɨl, the independent forms kap, and tak have been regarded as bases of out-to-output correspondence (cf. Kenstowicz 1996). In abreast with priority given to an independent form as a base with non-coronal obstruents, separation forms with t-final should be recognized as bases. Second, as Albright (2005, 2008) observed through computational investigation, nouns with unmarked case outnumber the case-marked nouns in Korean.[8] The margin in token frequency between them turns out to be significantly wide.

In this respect, my analysis is distinct from the s-final base proposed by Davis and H. Kang (2006) and H. Kim (2009). Also, the presence of bases in my analysis makes it different from the no-base analysis in inflectional morphology attempted by McCarthy (2005) and E. Han (2002).

3.2 The t-final base: further evidence from loanwords

Present-day Korean is known to lack underlying t-ending nouns. Historically, the morpheme final-t of Sino-Korean was incorporated into l, as observed by Martin (1997), and the historical t-ending native nouns shifted to s-ending as in [mot] 'nail' to [mos]. Thus, it seems to be foolhardy to invoke the banished sound t as a part of base in morphological mapping. However, alongside the phonological grounds in favor of t-ending as a base given in section 3.1, further supporting evidence can be found in loanword adaptations. First, let us examine the operations occurring to loanwords given in (14):

(14) Loanword adaptation
 a. tensification   bus[s']ɨ, toss [s']ɨ   vs.   pet[s]ɨl, set[s]ɨl

 b. ɨka~ i allomorphy   Davis[ɨka]   vs.   David[i]

 c. banning s-ending .   *nominative*   *accusative*   *locative*
                  mat   mɛtʰɨ-ka   mɛtʰɨ-lɨl   mɛtʰɨ-e
                         *mɛsi   *mɛsɨl   *mɛs-e

As noted in (14a), s-ending and t, d-ending loanwords undergo different ways of adaptation. Prevocalically, the input s manifests itself as tense s, whereas the input t realizes as lax s. In (14b), the input s requires nominative suffix -ɨka, while the input with d-ending shows allomorph -i. In (14c), s-ending stems are banned all the time, and instead, tʰ-endings exclusively arise. These kinds of morphophonemic or allomorphic alternations are not expected unless t, d- ending and s-ending loanwords are differentiated. In this sense, it would be safe to assume that s- and t, d-ending loanwords have different bases, and thus opens the door to permit t-ending nominal bases in Korean phonology.

Another supporting evidence for postulating t-ending bases, instead of s-ending, is observed in an experimental result. The multiple paradigmatic variation is observed by the perception test regarding s, ʧʰ, tʰ, ʧ, and t-endings. Citing the result of an experiment conducted by J. Jun and J. Lee (2007), the overall well-

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[8] At this point, I diverge from Albright's (2002 *et sequel*) in that the bases set up by Albright are quite different from its conceptualization in the paradigm uniformity, as in Benua (1997), Kenstowicz (1996), McCarthy (2005), in which only independent words are qualified as a base. However, for Albright, bases are privileged forms, from which speakers project unknown forms, regardless of whether they are independent words or not.

formedness is 4.34 to s, 3.33 to $\widehat{\mathfrak{t}\mathfrak{f}}^h$, 2.28 to t^h, 2.23 to $\widehat{\mathfrak{t}\mathfrak{f}}$, 2.13 to t, among five point scales, as charted in Figure 1.
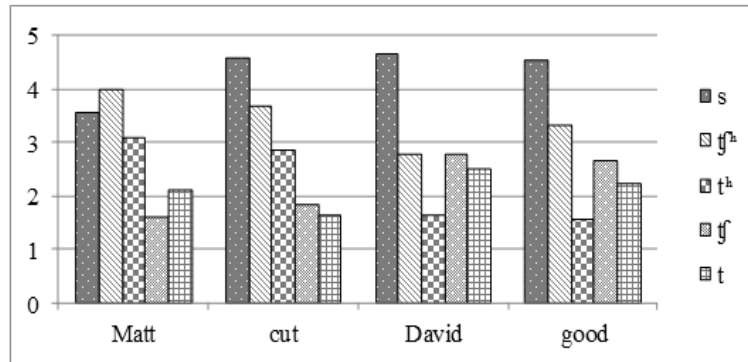

Figure 1.Well-formedness of loanword stem-endings (data from J. Jun and J. Lee (2007))

It is important to note that this experiment leads us to be skeptical about s-ending stems as the bases of Korean nominal inflection. If the hypothesis that all coronal obstruent-endings of loanwords are lexicalized as s-ending, as Davis and H. Kang (2006) and H. Kim (2009) vindicate, the multiple variation, as testified by the experiment result in Figure 1, does not make sense at all. From the s-ending base, except s, no other options are expected. Notice that the phonological process t→ s/ __i is feasible by virtue of assibilation, while the phonological process s →t, $\widehat{\mathfrak{t}\mathfrak{f}}^h$, $\widehat{\mathfrak{t}\mathfrak{f}}$, t^h/ __i is never attested, language-specifically or cross-linguistically.

3.3 An Optimality account

3.3.1 Analogical mapping

This section is concerned with offering an Optimality theoretic analysis for concerned Korean morphology. Remember that the base of inflection or derivation is in a position to control remaining morphology within a paradigm. The other criterion for the base is that they can exist as a separate word. In this sense, nominal inflection has a chance to possess a base. On the contrary, stems of non-nominal inflection, derivatives of nouns, verbs/adjectives, and adverbs, basically, fail to meet the conditions, since they are unable to stand alone without affixation. Let us examine nominal inflection first. To present a constraint-based analysis, constraints in (15) are given:

(15) a. Alignment (pw, σ, Left)
   The left sides of phonological word (pw) align with the left sides of syllable boundaries.

   b. *Ti]σ
   A tautosyllabic sequence consisting of a coronal stop followed by a high front vocoids is banned (T denoted coronal stops).[9]

   c. Analogical mapping[10]

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[9] The condition of tautosyllabicity of the sequence Ti rules out the application of assibilation to compounds as in pat^h#ilaŋ [pat-ilaŋ]/[pannilaŋ] *[$pa\widehat{\mathfrak{t}\mathfrak{f}}^h$ilaŋ] *[pasilaŋ]. I attribute the bleeding of affrication to the dominance of Alignment (pw, σ, Left) over *[Ti]σ [(cf. E. Han 1994). This issue will be made clear by the tableau (19) below.

[10] I do not exhaust the list of the analogical mapping between the base ending with t and outputs

t → s analogy: The base-ending t is mapped to s.
t → tɕʰ analogy: The base-ending t is mapped to tɕʰ.
etc.

    d. Ident Base-Output (Ident-BO)
       Features of the base are preserved in the output.

Going back to the paradigms exhibited in (1), the arithmetically possible combinations of each case form including the base of a nominal inflection escalates to one hundred and twenty-five (5^3 paradigms: mapping to s, tɕʰ, tʰ, tɕ, and t from t for each of three cases). From over one hundred possible paradigms, let us focus on those relevant to our concern, as given in (16). Considering that constraint Align(pw, σ, Left) is undominated in Korean, I skip this constraint in tableaux (16) to (18):

(16) t → s analogical mapping is effective

/pʰat/ 'red bean'	*Ti]σ	t→s analogy	t→ tɕʰ analogy	Ident-BO
a.<pʰat, pʰat-i, pʰat-ɨl, pʰat-e>	*!			
b.<pʰat, pʰas-i, pʰat-ɨl, pʰat-e>		*!*		*
c.<pʰat, pʰas-i, pʰas-ɨl, pʰat-e>		*!		**
→d.<pʰat, pʰas-i, pʰas-ɨl, pʰas-e>				***

(17) t → tɕʰ analogical mapping is effective

/pʰat/ 'red bean'	*Ti]σ	t→ s analogy	t→tɕʰ analogy	Ident-BO
a.<pʰat, pʰat-i, pʰat-ɨl, pʰat-e>	*!			
b.<pʰat, pʰatɕʰ-i, pʰat-ɨl, pʰatʰ-e>			*!*	*
c.<pʰat, pʰatɕʰ-i, pʰatɕʰ-ɨl, pʰat-e>			*!	**
→d.<pʰat, pʰatɕʰ-i, pʰatɕʰ-ɨl, pʰatɕʰ-e>				***

As to how to assign penalty marks to given paradigm members under the analogical mappings, I pursued the following protocol: a prior condition to trigger analogical mappings is the existence of a certain form to be copied by other members of a paradigm. For instance, to launch t→s analogy, it is essential for the root of one member to end with s. Accordingly, candidate (17a) vacuously satisfies t→s and t→tɕʰ analogy requirements. Meanwhile, in candidate (17b), members pʰatʰ-ɨl and pʰatʰ-e doubly violate t→tɕʰ analogy condition. The other thing is that the applicability of analogical mapping is decided in accordance with probability of concerned stem ending, as discussed in section 3.4.1. Given the current constraint ranking in (16) and (17), partially leveled paradigms (16b, c) and (17b, c) have no chance to win. Also, the underapplication of assibilation fatally penalizes the paradigms (16a) and (17a). The effect of the low ranked Ident-BO is invisible here. The same analysis applies to loanwords as well, as shown in (18):

(18) Loanwords

/pet/	*Ti]σ	t→ s	t→ tɕʰ	Ident-BO

ending with s, tɕʰ, tʰ, tɕ, and t. To save the space, among the five options, two types of mapping t→s and t →tɕʰ are exhibited.

		analogy	analogy	
a.<pʰet, pʰetʰ-i, pʰetʰ-il, pʰetʰ-e>	*!			
→b.<pʰet, pʰes-i, pʰes-il, pʰes-e>				***
→c.<pʰet, pʰetʃʰ-i, pʰetʃʰ-il, pʰetʃʰ-e>				***

The t→s analogy is favored over t→ tʃʰ in terms of frequency of the stem-ending obstrunts at hand and thus, (17b) is predicted to win. In this sense, candidate (18c) is a runner- up in its implementation

3.3.2 No analogy

As observed in section 3.2, aside from nominal inflection, with no other morphological alternations, analogical mapping takes place. First, compounds do not allow assibilation at all, as displayed in (19):

(19) compound

/pat#ilaŋ/	Align (pw, σ, L)	*Ti]σ	t→s analogy	t→tʃʰ analogy	Ident-BO
→a.pat.i.laŋ					
b.pa.ti.laŋ	*!	*			
c.pa.si.laŋ	*!				
d.pa.tʃʰi.laŋ	*!				

Candidate (19a) is immune from the penalization enforced by *Ti]σ, considering that the sequence ti is not tautosyllablic. Recall that t→s and t→tʃʰ analogy is irrelevant to compounds, considering that the analogical mapping is concerned with members of an inflectional paradigm.

   Next, let us turn our attention to affixational morphology, in which affrication to the exclusion of spirantization applies to non-nominal inflection and derivation. As discussed above, for those types of morphology are denied the bases of morphological operations. The absence of the base implies the irrelevance of constraint Ident-BO, as well. Instead, the constraint Ident Input-Output (stop) needs to be added:

(20) Ident-Input-Output (stop)
    Feature [stop] of input is preserved.

Under this idea, let us look at the following tableaux:

(21) Verbal/adjectival inflection

/mut-hi-ta/	*Ti]σ	t→s analogy	t→tʃʰ analogy	Ident-IO(stop)
a. mutʰita	*!			
→b. mutʃʰita				
c. musita				*!

(22) Derived nominal

/hɛtot-i/	*Ti]σ	t→s analogy	t→tʃʰ analogy	Ident-IO(stop)
a. hɛtoti	*!			
→b. hɛtotʃi				
c. hɛtosi				*!

(23) Derived adverbial

/katʰ-i/	*Ti]σ	t→s analogy	t→tʃʰ analogy	Ident-IO(stop)

a. kati	*!			
→ b. katʃʰi				
c. kasi				*!

Since the effect of the analogical mapping t → s or t→tʃ is nullified above, violation of *Ti]σ or Ident-IO(stop), if any, is fatal. For this reason, the second candidates in the tableaux (21) through (23) succeed to win.[11]

3.4 Non-phonlogical conditions for the analogy

3.4.1 Token/type frequency

In (16), (17), and (18), the choices of s- and tʃʰ-ending stems seem to have an equal chance in the prevocalic positions. However, as revealed by the loanword adaptation perception test and made explicit in Figure 1, the paradigms retaining coronal obstruents tend to skew towards s-ending. The pecking order is s > tʃʰ > tʰ > tʃ > t, as extensively discussed by Y. Kang (2003b), Albright (2008) and J. Jun (2010). Interestingly enough, that preference order is a mirror image of the token/type frequency revealed by the Korean corpus. To reconfirm whether the observation is true or not, I probed the Sejong Corpus and found that in terms of both token and type frequencies, s-ending is overwhelmingly greater than others by a significant margin, as shown in (24)[12]:

(24) Coronal obstruent-ending nouns in Korean

	S	tʃʰ	tʰ	tʃ	t	total
token	7287	2643	1543	523	0	11996
	60.8%	22.0%	12.9%	4.4%	0%	100%
type	432	172	99	17	0	720
	60.0%	23.9%	13.8%	2.4%	0%	100%

Once again, the statistical result confirms the previous literature that the predominance of s-ending stems in nominal inflectional paradigms is affected by token or type frequency of concerned forms.

3.4.2 A semantic conditioning

Another elusive puzzle remains yet to be resolved. Stems nested within inflected forms often reveal significant discrepancies among them, as addressed by K. Ko (1989), E. Han (2002), Y. Kang (2003b), C. Song (2009) among others.

(25) Resistence of locative/dative/goal

	a. spatio-temporal		b. others	
	/patʰ/'field'	/natʃ/'day'	/pʰatʰ/ 'red bean'	/natʃʰ/ 'face'
nominative	pasi	nasi	pʰasi	nasi
accusative	pasɨl	nasɨl	pʰasɨl	nasɨl
genitive	pasɨi	naɨi	pʰasɨi	nasɨi
locative/dative /goal	pat**ʰ**e	natʃe	pʰase	nase
directive	pasɨlo	nasɨlo	pʰasɨlo	nasɨlo
topicalized	pasɨn	nasɨn	pʰasɨn	nasɨn

The resistance to t→s analogy with locative/dative/goal ending in (25a), unlike (25b), is special. There seems to be a hidden pattern among apparent irregularities.

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[11] Belatedly, I noticed some notable analogy literature on Korean phonology related to my topic like B. Lee (2002), but it was too late to be incorporated into the current discussion.
[12] Albright (2008) attempts a similar investigation, but his report concentrates on a type frequency.

That is, the blocking of analogical mapping occurs to nouns with spatio-temporal meaning as noted in pat^h 'field' and natʃ 'day'. Our question is what would be in charge of otherwise paradigm uniformity. Previous literature has made an impressionistic surmise that frequency of concerned forms would be a culprit. To turn the speculation into an evidence-based argument, I examined the Sejong Corpus again. The results are as follows:

(26)   a. Overall

	t^h	tʃ^h	tʃ	sum
accusative	1903	2451	693	5047
loc/dat/goal	4529	556	417	5502
loc/acc %	237.9%	22.6%	60.2%	109.0%

b. Spatio-temporal accusative vs. loc/dat/goal

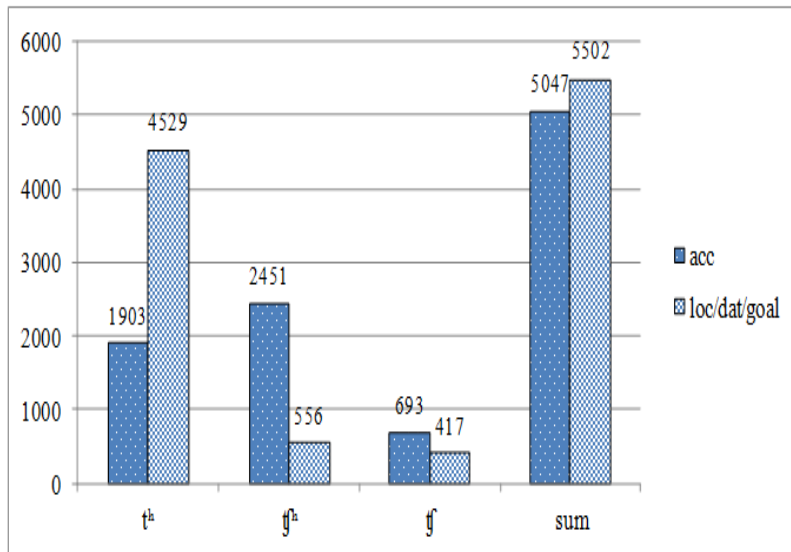|				
accusative	1334	30	66	1430
loc/dat/goal	3479	36	409	3924
loc/acc %	260.7%	120%	619.6%	274.4%

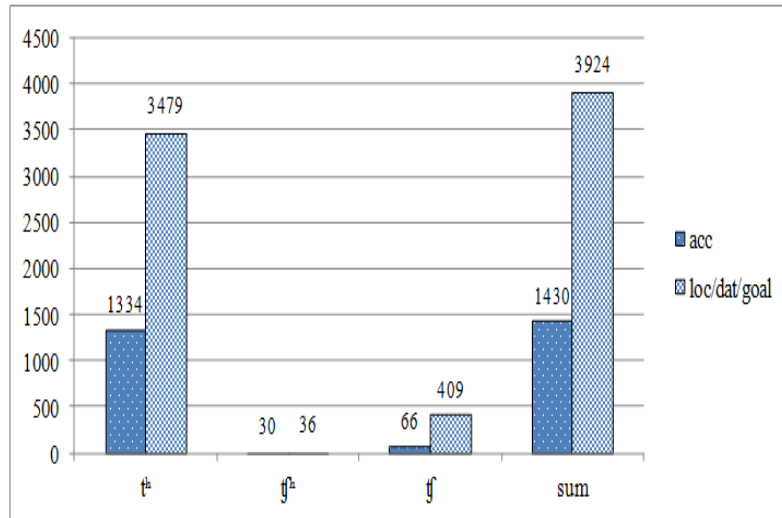**Figure 2. Token frequency: acc vs. loc/dat/goal: overall**

Figure 3. Token frequency: acc. vs. loc/dat/loc: spatio-temporal

Now, it is clear what is responsible for the resistance of locative/ dative/goal case as to assibilation. As shown by the tabulation in (26) and charted in Figure 2 and 3, the token frequency is obviously involved with the inflection alternations. Let us compare the overall frequency of loc/dat/goal forms with that of stems with semantic property of space and time. The frequency of accusative forms is used as a baseline for the comparison. The average ratio of loc/dat/goal over accusative is 109.0% (Figure 2). By contrast, the specific ratio focusing on spatio-temporal stems escalates to 274.4% (Figure 3), which is two times more than the average. This result aligns with Bybee's (2001) contention that high-frequency words are less affected by analogy.

3.4.3 Normative rules: intervention of orthography

In the preceding subsection 3.4.2, it is stated that the favorite mapping t to s or t͡ʃ^h is due to the fact that the analogical mapping is affected by the token or type frequency of concerned paradigm members. Still, this is not sufficient to explain the whole gamut of inflection. As represented by shaded and crossed out marks in (27), in fact, a substantial part of projected forms of inflection are disallowed:

(27) Conventional nominal ending orthography: <-t^h, -t͡ʃ^h, -t͡ʃ>

orthography	<-t^h>	<-t͡ʃ^h>	<-t͡ʃ>
mapping	sot^h 'kettle'	pit͡ʃ^h 'light'	kut͡ʃ 'exocism'
a. t → s	sosɨn	pisɨn	kusɨn
b. t → t͡ʃ^h	sot͡ʃ^{h}ɨn	pit͡ʃ^{h}ɨn	*kut͡ʃ^{h}ɨn
c. t → t^h	sot^{h}ɨn	*pit^{h}ɨn	*kut^{h}ɨn
d. t → t͡ʃ	*sot͡ʃɨn	*pit͡ʃɨn	kut͡ʃɨn
e. t → t	*sotɨn	*pitɨn	*kutɨn

A couple of questions come to mind: First, if the analysis of analogical mapping based on surface-true base forms is correct, what are the origins of the disparity among the three words noted above? Notice that t→ t^h mapping only applies to <sot^h>'kettle'. Oppositely, for <kut͡ʃ> 'exocism', the expected forms [kut͡ʃɨn] and [kusɨn] rarely arise. For <pit͡ʃ^h>'light' only –s and -t͡ʃ^h-endigs are allowed. For handling that puzzle, I would like to propose an unconventional solution by invoking the normative pressures felt by Korean speakers. It would be difficult to deny that the pattern of Korean is significantly affected by normative rules that require adequate dictions to comply with the orthography, which has been respected as a prestigious style. Admitting that the idea that a language-specific

spelling system affects sound pattern of a language is not conventional, it is noteworthy that there is a growing literature supporting the influence of orthography upon sound pattern. For instance, for the analysis of German assibilation, Hall (2004) calls on orthographic constraints (28):

(28) German Assibilation t → ts / ___ j in suffixes such as –ion, ial, -iös,
iell etc. (Hall 2004: 1049)

   a. Apply
    Installation [ɪnstalatsjo:n]
    essential [ɛsentsel]

   b. Not apply when spelled <ti>, <th>, <tj>
   <ti> Kation [katjɔn] 'cation', <th>Ä thiopien [ɛtjo:pjən] 'Ethiopia',
   <tj> Matjeshering   [matjəshe:ʀɪŋ] 'young salted herring'

Unlike in (28a), in (28b) /tj/ sequences, which otherwise would have undergone the assibilation, are immune from the process. Hall tries to account for the systematic gap from the viewpoint that spelling controls sound pattern. I think the same thing happens to the analogical mappings from the base-final /t/ to actual surface forms. In other words, orthographical convention affects the actual morphological processes

4. Conclusion and implications

In this article, I have argued that Korean nominal inflection is inadequate to be couched within a phonological assibilation approach. The upshot is that the assibilation approach is unable to explain the asymmetry that the assibilation, via either affrication or spirantization, exclusively applies to the nominal inflectional morphology. For the standout of nominal inflection, I seek an analysis based on analogical mapping from bases to surface forms as part of paradigm extension. To implement the purpose, setting up a proper base is a prerequisite, and in this context, I offer a t-ending base hypothesis. Solid phonology-internal and external evidence supports the present contention, despite that Korean lacks underlying t-ending nouns. The idea in favor of unaffixed forms as bases keep parallelism with those of non-coronal cases like kap of /kaps/ 'price' and tak of /talk/ 'chicken'. The token/type frequency of t-ending separation form also lends support to my contention. In addition, t- and s-ending inputs for loanword adaptation make a difference as part of tensification of stem ending, and the case marking allomorphy. The analogical mapping coupled with t-ending base serves to explain the asymmetry that the analogical mapping exclusively applies to nominal inflection. The analogical approach is sufficient when it is bolstered by extra-phonological factors such as token or type frequency of relevant items, semantic conditioning factor, and conformity to orthographic convention.

   The analogical mapping approach to Korean nominal inflection incites significant implications to the future research to the related topic. Above all, it shows that morphological bases are required in inflection, let alone in derivational processes, contrary to McCarthy (2005). Second, it appears to support the contention that bases are selected among the surface-true representations, as argued by Hayes 1999, Albright 2008, Becker 2009. Last but not least, for assuring a proper description of Korean inflectional morphology, we need to consider the intervention of non-phonological factors such as token or type frequency, semantic factors, orthography, instead of abstract structure as offered by Becker (2009).

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