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Korean Vowel Mergers: Contrastive Hierarchies and Distinctive Features

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Abstract

The present paper provides a contemporary viewpoint of phonological representations. Specifically, I present contrastive hierarchies of distinctive features adopting the Modified Contrastive Specification (MCS, Dresher, Piggott and Rice 1994, Dresher 2008, 2009) and the dimension hypothesis (Avery and Idsardi 2001, Purnell, Raimy and Salmons 2018). Under these frameworks, I reanalyze and revise Ko's (2009) proposals on the contrastive hierarchies of Korean vowels. The two-step merger of a low back vowel from Late Middle Korean to Early Modern Korean exemplifies how the modified hierarchies can provide a more efficient and systematic account. As for synchronic examples, I illustrate a merger of a low high front and a mid high front vowel and a feature unpacking phenomenon of high front rounded vowels under the proposed hierarchies. Furthermore, Oxford's (2015) model for sound change is applied to evaluate the revised representations. The diachronic and synchronic sound change data are well verified by his model. I argue that the representations proposed in this study hold their advantages as they offer more economical and consistent explanations for sound changes.

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1 Introduction

The present article examines sound changes of Korean vowels from a contemporary viewpoint of phonological representation. The three goals I aim to achieve are: (1) to illustrate phonological representations of Korean vowel systems adopting Modified Contrastive Specification (MCS, Dresher, Piggott and Rice 1994, Dresher 2008, 2009, et seq.) and a feature geometry based on the dimension hypothesis (Avery and Idsardi 2001); (2) to revise and improve Ko's (2009) analysis of sound changes of Korean vowel systems founded on (1); lastly, (3) to apply Oxford's (2015) proposals about sound change to the revised Korean vowel representations.

This study builds upon Ko's (2009) research where he presents contrastive feature hierarchies as typologically plausible accounts for the evolution of Korean vowel systems. Ko and I follow the idea of Contrastivist Hypothesis (Hall 2007, Dresher 2009) assuming that only contrastive features which distinguish phonemes are active in the phonological grammar. Also Ko's research and this study follow the Successive Division Algorithm (Dresher 2008, 2009) for determining the feature order in the feature hierarchy. The difference lies in that the revised representations adopt Avery and Idsardi's feature geometry. With the modified representations, I re-examine some of the diachronic vowel changes presented in Ko and argue the revised models can offer a more economical answer to sound changes. In addition, I present two on-going sound changes of Modern Korean to exemplify the advantages of the revised representations.

Oxford's (2015) model of sound change is adopted to evaluate whether his model can account for Korean vowels. In his work, Oxford conducts a formal analysis of the diachronic vowel changes of Algonquian languages which is also founded upon MCS. He develops four hypotheses of sound change which are introduced in Section 2.3.

Overall, this paper demonstrates how contemporary phonological representations highlighting contrastive hierarchies of distinctive features can improve proposals from previous research and provide new insights into sound change (in line with Ko 2009, Oxford 2015, and Purnell, Raimy and Salmons 2018, to name a few).

2 Theoretical Framework

2.1 The Model of Distinctive Features

Avery and Idsardi (2001) claim that representational economy is crucial in phonology. That is, phonological representations should be non-redundant and minimally specified. They also argue that phonetic gestures are privative in nature and are organized by phonological dimension nodes which are the basis of contrast in our grammar. Based on these ideas, they propose a model of distinctive features which is organized by articulators, dimensions, and terminal phonetic gestures. Although the feature geometry is not a brand-new concept, Avery and Idsardi's model (hereafter the AI model) is novel in that their proposal operates on dependent gestures organized by dimension nodes (Purnell and Raimy 2015).

The dimension nodes are inspired by general motor control research where most "muscle groups form antagonistic pairs" (Avery and Idsardi 2001:44). For example, the Tongue Height dimension governs the phonetic gestures [high] and [low] where either one gesture can be present but not both simultaneously. Purnell, Raimy, and Salmons (2018) further develop the AI model as shown in Figure 1.

We can discuss three different levels of representations referred to as phonological, phonetic-phonological, and phonetic (Purnell and Raimy 2015:527). Firstly, within the AI model, the phonological level is encoded by *dimensions*. Since dimensions represent abstract and cognitive aspects, we need more detailed surface representations. To be pronounceable, each dimension needs to be filled in with a gesture, which Avery and Idsardi refer to as *completion rules* which can be language-universal or language-specific. The outcome *gestures* can be considered as a phonetics-phonology interface. Lastly, the phonetic level captures a more specific description of a sound segment achieved by *enhancement*. For my purpose, I focus on the phonological and the phonetic-phonological level, namely dimensions and gesture (see Avery and Idsardi 2001, Purnell and Raimy 2015, Purnell, Raimy, and Salmons 2018 for further discussions).

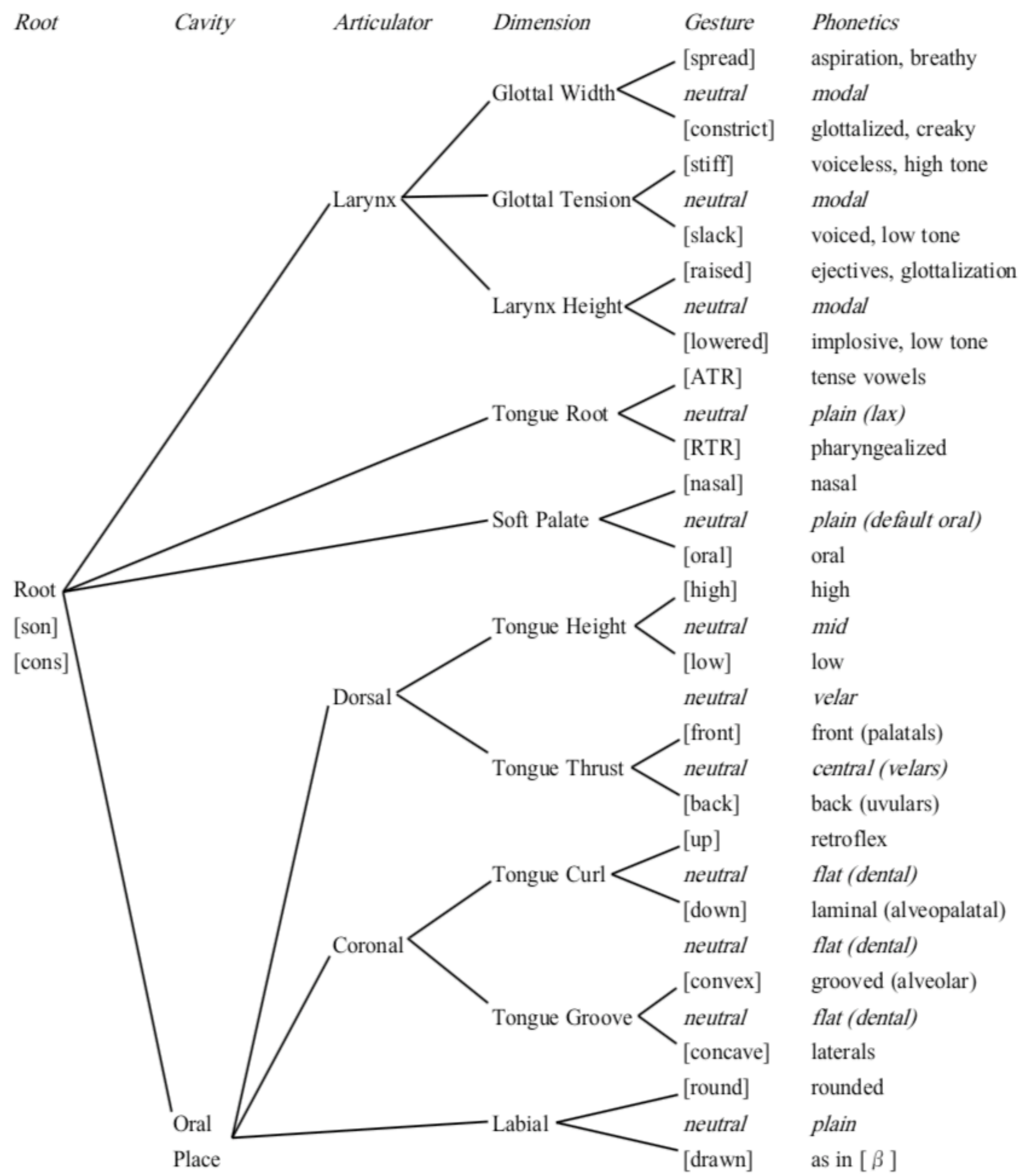


Figure 1: Modified Avery and Idsardi's model of distinctive features (Purnell, Raimy, and Salmons 2018:19).

In short, the underlying representation of phonemes is exhibited by the presence or absence of dimensions. Concrete phonetic gestures are filled in by completion rules where dimensions gain phonetic values. The dimension hypothesis provides a basis for phonemic descriptions, serving as a building block in the phonological grammar. The order in which the building blocks are stacked is determined by the Successive Division Algorithm (Dresher 2008, 2009) discussed in the next section.

2.2 The Successive Division Algorithm

Avery and Idsardi (2001), Hall (2007), and Dresher (2008, 2009) claim that only contrastive features are active in the phonological grammar. Dresher further argues that features form a hierarchical order by the Successive Division Algorithm (SDA). A simplified version of SDA is presented in (1) (see Dresher 2008:22 for the formal account):

(1) Successive Division Algorithm
  a. Begin with no feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
  b. If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows.
  c. Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.
  (Dresher 2009:16)

Following this algorithm, any distinctive feature system can form a hierarchy. The next section exemplifies how a hierarchy of features can account for sound changes. In Section 3, I present Korean vowel hierarchies from Ko (2009) and the modified hierarchies I propose. The hierarchies are similar in that they follow the framework of the MCS and SDA; the hierarchies are different in that they choose different theories of distinctive features. Ko uses features in square brackets (e.g., [coronal], [low]) whereas I employ dimension terms from the AI model (e.g., Tongue Thrust, Tongue Height) where specific gestures (e.g., [front], [high]) is implied in the completion rule. Thus, the two hierarchy may distinguish a set of vowels with the same contrast but the contrast may be marked differently. For example, the first two contrasts are [coronal] and [low] in Ko's work. Interpreting those contrastive features into the AI model, Tongue Thrust and Tongue Height are used respectively.

2.3 The Model of Sound Change

Building from the ideas of distinctive features and contrastive hierarchies, Oxford (2015) demonstrates how phonological implications can contribute to a model of sound changes. He features the influence of phonologically contrastive patterns by observing historical vowel changes of Algonquian languages. Combining the contrastivist hypothesis (Hall 2007, Dresher 2009) and a privative feature system, he asserts that the proposal is "a strongly and explicitly constrained model of phonological activity and typology" (Oxford 2015:311). The following sound change hypotheses are closely relevant to the goal of this paper:

(2) Sound change model
  a. Contrastivist hypothesis: Only contrastive features are phonologically active.
  b. Sisterhood merger hypothesis: Structural mergers apply to 'contrastive sisters.'
  c. Contrast shift hypothesis: Contrastive hierarchies can change over time.
  d. Segmental reanalysis hypothesis: A segment may be reanalyzed as having a different contrastive status.
  (Oxford 2015:351)

The Contrastivist Hypothesis is the foundational assumption as the contrastive features play an important role in SDA. The sisterhood merger hypothesis (SMH) is a constraint of structural mergers involving only contrastive sisters where sisters are two nodes immediately dominated by the same node. In other words, structural mergers apply to a segment or a subset of segments differing in one contrast under the same mother node. The contrast shift hypothesis (CSH) means that contrastive hierarchies are not immutable but can be reordered over time. Oxford (2015) claims that CSH is inevitable for diachronic analyses but should be applied sparingly to keep the restrictiveness of the model. Lastly, the segmental reanalysis hypothesis (SRH) allows phonemes to be marked with different contrast in diachronic analyses if necessary. The following section shows how these hypotheses are applied to the phonological structures of Korean vowel changes and how they account for diachronic and synchronic vowel changes.

3 Korean Vowel Changes and Feature Hierarchies

In his study, Ko (2009) observes the evolution of the Korean vowel system, specifically, historical developments of the vowels from Late Middle Korean (LMK, 15th – 16th century) through Early Modern Korean (EModK, 17th – 19th century). His research and the present paper are similar in the sense that both follow the framework of Modified Contrastive Specification (MCS) and Successive Division Algorithm (SDA). However, I deviate from Ko's proposals by employing the AI model of distinctive features. The next section introduces Ko's proposal and then, based on Ko's analysis, the following subsections illustrate revised contrastive hierarchies of LMK, EModK, and ModK. Under these modified representations the vowel changes are explained. In addition, hypotheses of sound change (Oxford 2015) are applied to evaluate the modified representations.

3.1 Diachronic Changes: Ko's Account

The LMK vowel system consists of seven vowels. Ko (2009) suggests an "RTR-based two-height system with the contrastive hierarchy [coronal] > [low] > [labial] > [RTR]" as illustrated in Figure 2. Comparing with the AI model, [coronal] is equivalent to Tongue Thurst completed with [front]; [low] is Tongue Height completed with [low], [labial] is Labial completed with [round], and [RTR] is Tongue Root completed with [RTR]. Note that the [RTR] feature in Ko and the present study does not imply tense or lax vowels but provides a secondary means for marking low vowels.

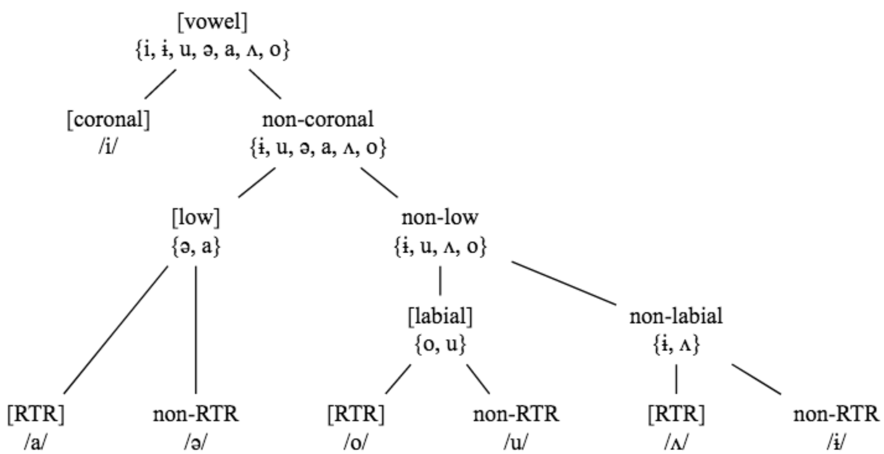


Figure 2. Late Middle Korean contrastive hierarchy: [coronal] > [low] > [labial] > [RTR] (modified from Ko 2009:7).

First merger: /ʌ/ in non-initial syllables	Second merger: /ʌ/ in initial syllables
a. /han**ʌ**l/ > /han**ɨ**l/ 'sky' b. /tar**ʌ**-/ > /tar**ɨ**-/ 'different'	a. /p**ʌ**ram/ > /p**a**ram/ 'wind' b. /t**ʌ**l/ > /t**a**l/ 'moon'

Table 1. The change of /ʌ/ from LMK to EModK (Ko 2009:9).

The low back vowel *alay-a* or /ʌ/ is an extinct vowel in ModK which has undergone a distinct two-step merger through LMK to EModK (Ko 2009). The first merger of /ʌ/ to /ɨ/ occurred in the 16th century (LMK), specifically in non-initial syllables (Table 1). Under the hierarchy (Figure 2), /ʌ/ and /ɨ/ form a sisterhood; /ʌ/ collapses to /ɨ/ as a result of the loss of [RTR] contrast where it is the only place that /ʌ/ can merge into. The first merger is supported by "the notion of *minimal contrast* and *phonological merger*" meaning "a phonological merger operates based on a minimal contrast" (Ko 2009:10). In essence, Ko's idea is parallel to Oxford's SMH; therefore, the first merger of /ʌ/ can be well accounted by SMH, a constraint stating that only contrastive sisters render structural mergers.

Later on in EModK (the mid 18th century), the second merger of /ʌ/ to /a/ takes place. However, this merger cannot be supported by SMH as they are not sisters in Figure 2. Evolving to EModK, Ko asserts that the first merger of /ʌ/ triggered the reanalysis of the LMK phonological representation, which can be supported by Oxford's SRH. Following Ko's argument, the evolution rendered a segmental reanalysis and eventually affected the order of the contrasts. That is, the hierarchy of EModK changed from LMK by inserting [high] above [labial] and deleting the lowest feature, [RTR]. Accordingly, a new layout of vowels (Figure 3) was generated where /ʌ/ and /a/ form a sisterhood. Therefore, under the new contrastive hierarchy, /ʌ/ and /a/ became a candidate for a possible merger as they formed a sisterhood which eventually happened.

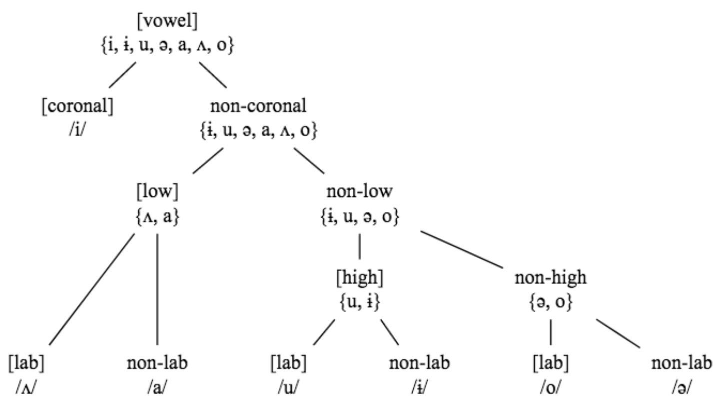


Figure 3. Early Modern Korean contrastive hierarchy: [coronal] > [low] > [high] > [lab] (modified from Ko 2009:10).

3.2 Diachronic Changes: Revising Ko's Account

According to Ko's argument, the first merger led to the loss of the [RTR] contrast in the vowel system but the remaining features, [coronal], [low], and [labial], were not enough to maintain the vowel space. Therefore, a new contrast [high] was inserted into the system. However, the reasons for feature deletions/insertions and re-ranking are not fully justified. To resolve this problem, I will first reanalyze Ko's models and then explain the mechanism of sound changes with Oxford's hypotheses. Ko's data mainly covers monophthongs and as one of the main goals of this study is to reassess and revise his proposal, vowel data here deals with sound changes of monophthongs as well.

Unlike other feature-based analyses, the AI model posits dimensions (e.g., Tongue Thrust, Tongue Height, Labial) as the contrastive features, not gestural features (e.g., [front], [high], [round]). Each language has completion rules which are encoded in the phonological grammar. Once the rules are applied, the dependent gestures are realized which are commonly understood as the phonetic level of sounds. To build a hierarchical representation, SDA guides the order of features. The dimension-based feature hierarchy and relevant completion rules (resulting in gestures) are in square brackets as shown in Table 2. The terminal gestures are mostly identical to Ko's analysis, but I argue that Tongue Height (TH) is completed with [high], not [low]; I also follow Purnell, Raimy, and Salmons's (2018) claim that Tongue Root (TR) completed with [RTR] ([retracted-tongue root]) not only indicates pharyngealized sounds but also low in terms of vowel space.

Dimension	Tongue Thrust	Tongue Height	Labial	Tongue Root
Gesture	[front]	[high]	[round]	[RTR]

Table 2: Completion rules for Korean vowel system.

Figure 4 and Figure 5 are the revised feature hierarchies from Ko's work. At the highest level, vowels are distinguished from consonants and glides marked by [vowel]. In both LMK and EModK, Tongue Thrust (TT) completed with a [front] gesture isolates the high front vowel /i/ from the others. Then, Tongue Height (TH) completed with [high] separates the vowels into two subsets. Up to this level, the order of contrast and the hierarchical tree are fundamentally same as Ko's.

The order of the bottom two features is where the differences arise between the original hierarchies and the revised hierarchies. The lower two features make a distinction between the phonological grammar of LMK and EModK. In LMK, Labial divides the subset marked with TH, and then TR completed with [RTR] marks the last contrast. The subset of two vowels unmarked with TH does not show Labial contrast but utilizes TR to distinguish the two non-high vowels (Figure 4). On the contrary, the third distinctive feature of EModK is TR, and then Labial distinguishes the vowels (both dimensions completed with the same rules) (Figure 5). In other words, the change between LMK and EModK simply lies on switching the bottom two features. Unlike Ko, feature insertion and deletion are unnecessary.

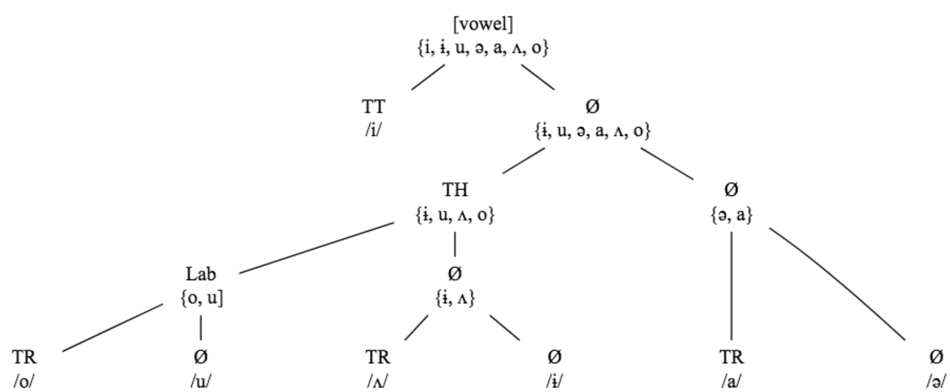


Figure 4. Middle Korean contrastive hierarchy revised: TT > TH > Lab > TR.

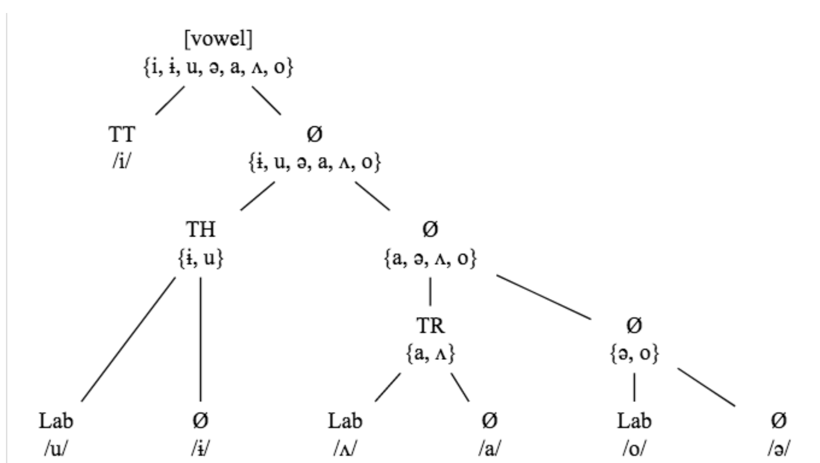


Figure 5. Early Modern Korean contrastive hierarchy revised: TT > TH > TR > Lab.

As Figure 4 shows, /ʌ/ and /ɨ/ form a sisterhood that only differs in the presence/absence of the TR dimension where SMH supports the /ʌ/ to /ɨ/ merger. The loss of TR eventually triggered a feature reranking supported by CSH. The altered hierarchy establishes a sisterhood of /ʌ/ and /a/ implying a candidate for sound change. The vowel merger indeed happened later in the EModK era when /ʌ/ lost its Labial contrast and merged into /a/. Again, SMH verifies the second merger of /ʌ/ in the initial positions.

In Section 3.1, I presented the two-step merger of /ʌ/ from LMK to EModK (Ko 2009). Section 3.2 illustrated how Ko's hierarchies can be interpreted by the AI model. Table 3 shows the order of the contrastive features of Ko's original hierarchy and the revised hierarchies and the corresponding completion rules. Both studies are similar in that they follow the idea of contrastivist hypothesis (Hall 2007, Dresher 2009) and SDA (Dresher 2008, Dresher 2009) to generate hierarchical structures. The sequential merger of /ʌ/ is well supported by SMH which is in line with Ko's argument where he states phonological mergers are operated when having a minimal contrast. However, Ko's proposals need further elaboration to justify feature reanalyses and reranking. Ko's analysis requires an additional step of segmental reanalysis, i.e., the contrastive features of a few vowels have been readjusted evolving from LMK to EModK as Ko inserts of a new feature (i.e., [high]) and deletes an existing feature (i.e., [RTR]) (Table 3). This problem can be solved when employing the AI model. As stated in Table 3, the revised hierarchy only needs to change the two bottom features; this makes a strong contrast with Ko's hierarchy where a new feature is added to while an existing feature is deleted from the hierarchy. In terms of the vowel merger example, the fact that the order of the dimension has changed but not the completion rules is also important in terms of providing a consistent and systematical account. Altogether, the revised hierarchies deliver a more economical and consistent account for historical sound changes justified by SMH and CSH.

	Ko's hierarchy	Revised hierarchy
LMK	[coronal] > [low] > [labial] > [RTR]	TT > TH > Lab > TR
EModK	[coronal] > [low] > [high] > [labial]	TT > TH > TR > Lab
Completion Rules	N/A	TT [front], TH [high] Lab [round], TR [RTR]

Table 3. Contrastive hierarchies of distinctive features for LMK and EModK.

3.3 Synchronic Changes

Across the evolution of the language from LMK to EModK and ModK, substantial changes have been witnessed; regarding the vowel system, off-glide diphthongs have been monophthongized, and triphthongs have been diphthongized (Sohn 2001). A full detailed analysis of the vowel changes from EModK to ModK is beyond the scope of the present article and is left to future research. Here I present a contrastive hierarchy of standard Korean, which is the Seoul (the capital city of South Korea) dialect. Two exemplary vowel changes of ModK are examined with revised phonological representations and provide insight into sound changes from the contrastive hierarchy of distinctive features perspective.

According to the National Institute of Korean Language (NIKL), ModK consists of ten orthographically distinguished monophthongs {i, y, e, ø, æ, ɨ, u, ʌ, o, a}. The feature hierarchy is TT >TH > TR > Lab which is identical to EModK (Figure 6) and with the same completion rules (Table 2). This contrastive hierarchy supports two on-going vowel changes in ModK: the diphthongization of front round vowels and the /e/~/æ/ merger.

Although, the NIKL claims that the vowel system of Standard Korean is comprised of 10 monophthongs, many linguists argue and provide acoustic evidence that ModK speakers rarely pronounce /y/ and /ø/ as monophthongs but instead as diphthongs, [wi] and [we] respectively (Sohn 2001, Shin 2011). This argument is generally agreed upon resulting in an 8-vowel system (Figure 8). The NIKL also comments in the official *Phyocwune Kyuceng* (Standard Language Regulation) that /y/ and /ø/ can be pronounced as diphthongs despite their orthographic distinctiveness. I refer to this phenomenon as "feature unpacking" of front rounded vowels.

According to Figure 6, /y/ is marked with TT, TH, and Lab while /ø/ is marked with TT and Lab. In the previous section, I explained that /ʌ/ lost its Labial dimension and merged into its sister /a/ in EModK. In ModK, the Labial dimension of /y/ and /ø/ retains the rounded phonetic value but seems to release in different time slots (Figure 7). In other words, rather than losing the contrastive of Labial, the Labial dimension is maintained but does not occur simultaneously as a rounded vowel.

The front rounded vowels unpack their feature in different x-slots resulting in a diphthongal structure. For example, when we set Labial aside from /y/, the remaining features are [vowel], TT, and TH, which are equivalent to the contrastive features of /i/, the sister of /y/. Therefore once Labial is released as an onglide [w], the following slot is filled in with its sister vowel (Figure 7b). Same logic can be applied to /ø/. Table 4 demonstrates examples of /y/ and /ø/.

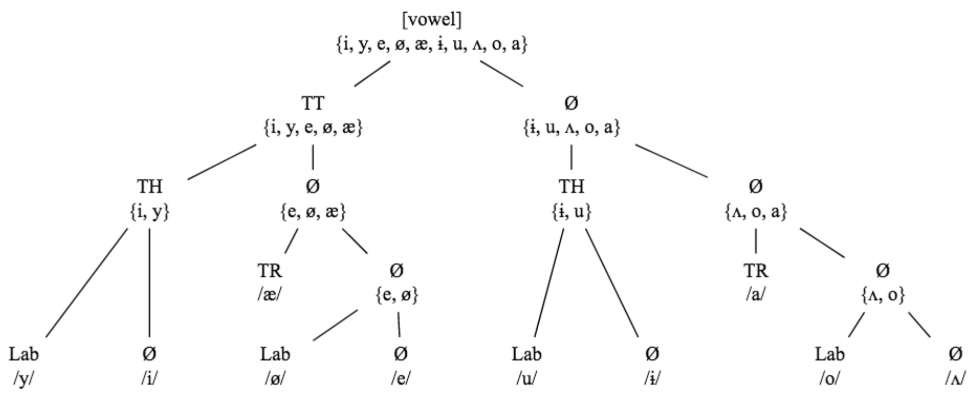
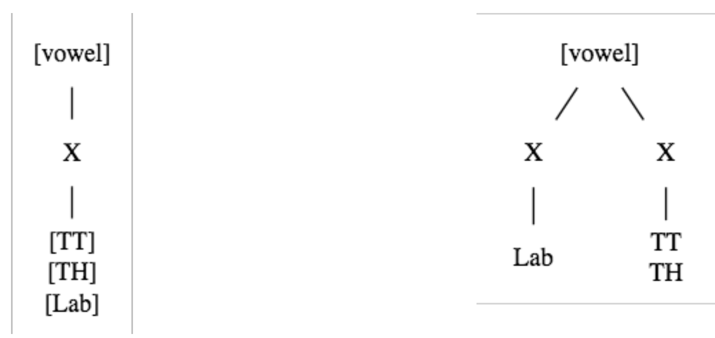


Figure 6. Modern Korean contrastive hierarchy: the 10-vowel system.



a. /y/ in a single timeslot b. /y/ in two timeslots resulting as [wi]

Figure 7. Unpacking features in different timeslots.

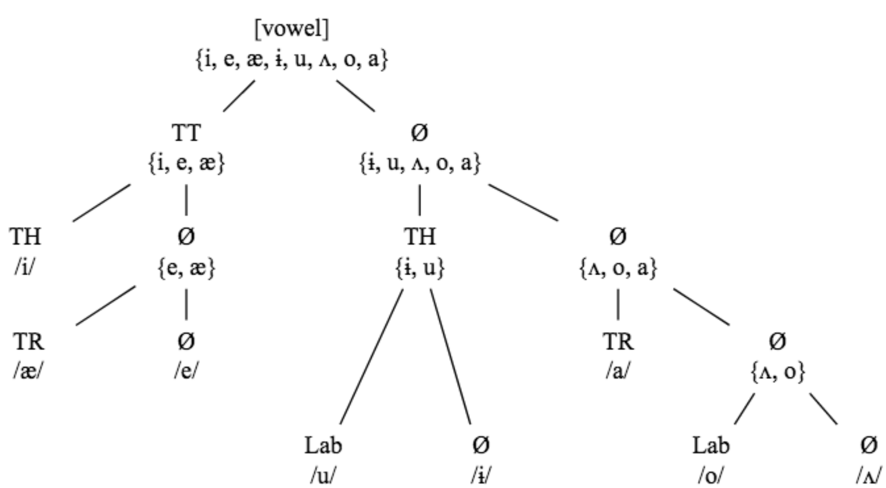


Figure 8. Modern Korean contrastive hierarchy: the 8-vowel system.

Hangeul (Korean alphabet)	ㅟ	ㅚ
Phonemic	/y/	/ø/
Phonetic	[y]~[wi]	[ø]~[we]
Example	a. <귀> *ear*: /ky/ > [ky]~[kwi] b. <뒤> *back*: /ty/ > [ty]~[twi]	a. <뇌> *brain*: /nø/ > [nø]~[nwe] b. <쇠> *iron*: /sø/ > [sø]~[swe]

Table 4. The change of front rounded vowels.

Another recent merger is the /e/~/æ/ merger. After losing the two front rounded monophthongs, the ModK vowel system has consisted of eight vowels including three front vowels {i, e, æ} and five back vowels {ɨ, u, ʌ, o, a}. Some linguists go further and argue that contemporary Korean consists of seven monophthongs, asserting that the non-high vowels have merged together (Shin 2011). The Korean alphabet for /e/ and /æ/ are still distinguished in orthography because the Korean writing system is phonemic; however, the non-high front monophthongs are rather considered as allophones or free variants (Sohn 2001, Shin 2011) as shown in Table 5. For example, /ke/ *crab* and /kæ/ *dog* are minimal pairs but speech data evince that the pronunciation of these two words is indistinguishable, [ke]~[kæ]~[kɛ] (Shin 2011). Loanword transliteration also supports the loss of contrast of TR for ModK speakers. For instance, ModK speakers transliterate English /e/ or /æ/ to Korean /e/ or /æ/ as a free variation. The 7-vowel system is depicted in Figure 9.

Hangeul (Korean alphabet)	ㅔ	ㅐ
Phonemic	/e/	/æ/
Phonetic	[e]~[æ]~[ɛ]	
Example	<게> *crab* /ke/: [k**e**]~[k**æ**]~[k**ɛ**]	<개> *dog* /kæ/: [k**e**]~[k**æ**]~[k**ɛ**]

Table 5. The /e/ ~ /æ/ merger.

To interpret this vowel merger into the proposed model, the TR dimension (completed with [low]) loses its contrast where /æ/ merges to its sister /e/ supported by SMH. Accordingly, TT (completed with [high]) is the only contrast that marks the distinctive features of front vowels in ModK's latest vowel system.

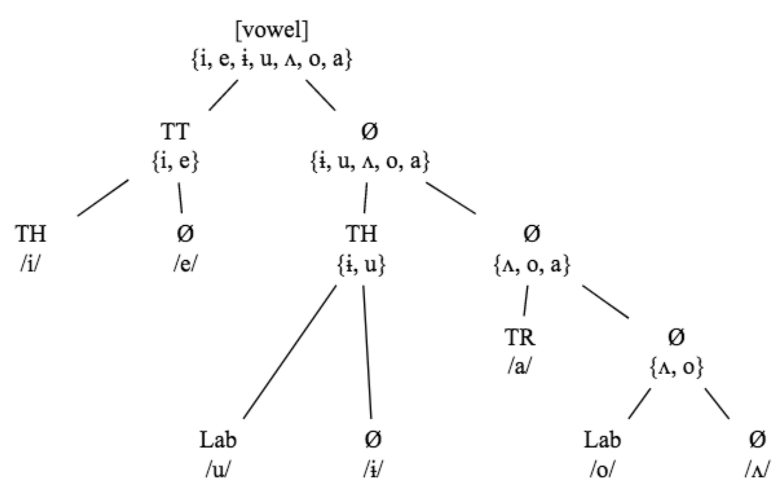


Figure 9. Modern Korean contrastive hierarchy: the 7-vowel system.

So far, three different contrastive hierarchies for ModK vowel systems have been presented. Following the conservative viewpoint, ModK comprises of ten vowels (Figure 6); moving away from the most conservative view, ModK consists of eight vowels (Figure 8) or seven vowels (Figure 9). These vowel changes develop from segments at the bottom level where SMH plays a role and provide sufficient accounts. It is noticeable that the feature hierarchy of ModK remains the same as EModK and the completion rules are stable from LMK to ModK.

4. Conclusion

In this article, I have illustrated how contemporary views on phonological representations can offer accounts for sound changes. Specifically, I have suggested contrastive hierarchy employing Modified Contrastive Specification (MCS, Dresher, Piggott and Rice 1994, Dresher 2008, 2009, et seq.) and dimensional feature geometry (Avery and Idsardi 2001).

Springing from Ko's (2009) research, I have presented modified hierarchies of his prior study on Korean vowel systems and interpreted his hierarchies under MCS and the AI model. The revised contrastive hierarchies confirm that Korean vowel systems are well accounted under the contemporary phonological representations along with Ko (2009). Furthermore, the updated representations show that they can provide more economical accounts for vowel changes since they require fewer conditions and do not need any segmental reanalysis (i.e., the completion rules remain the same, at least, from the 15th century). In addition, the current analyses confirm the validity of sound change hypotheses proposed by Oxford (2015).

With the revised hierarchical representations, future study should include extensive examples of diachronic sound changes to bolster the present approach. Also, I believe that expanding the vowel data to dialects other than Seoul would provide more insights in understanding sound changes and phonological research.

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