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Beyond [o]-raising: A chain shift analysis of Seoul Korean back vowels

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Lee, Jungah, Eun Jong Kong, and Kaori Idemaru. 2026. Beyond [o]-raising: A chain shift analysis of Seoul Korean back vowels. *Linguistic Research* 43(1): 141-162. Recent studies have documented the raising of the mid-back vowel [o] toward the high-back vowel [u] in Seoul Korean (SK), raising questions about whether this shift reflects a merger or a chain shift. This study investigates whether [o]-raising induces a reorganization of the vowel space involving adjacent vowels [u], [ʌ], and [ɯ]. Analyzing vowel productions from 22 SK speakers (16 female, 6 male) across two speech styles (careful vs. conversational), we examined acoustic properties of three vowel pairs: [o]-[u], [ɯ]-[u], and [ʌ]-[o]. Results show that [u] remains distinct from [o] and is produced in a significantly more fronted position, especially in conversational speech. Additionally, [u] was shifted closer to [ɯ], and [ʌ] raised, suggesting a broader vowel chain shift. These findings provide acoustic evidence of an ongoing, systemic restructuring of the SK vowel system. **(Chungbuk National University · Korea Aerospace University · University of Oregon)**

Keywords Korean vowels, sound change, speech production, vowel merger, chain shift

1. Introduction

When one phoneme invades another phoneme's phonetic territory, and the latter phoneme does not change, the phonemic contrast may disappear, resulting in a merger of the two (Gordon 2011, 2013; Labov 2011). Mergers can happen gradually over time, as the articulation of the vowels becomes more similar and the phonemic distinction between them is lost. In another scenario, when a phoneme becomes similar to another phoneme, and the latter phoneme does change so that the contrast is

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maintained, this results in what is called a chain shift. In this study, we investigate whether a chain shift is underway in the vowel productions of Seoul Korean (SK), where [u] is being fronted after [o] has risen to or near the space previously occupied by [u]. While the raising of [o] has been robustly documented (e.g., Han and Kang 2013; Jang and Shin 2007; Seong 2004), only a limited number of studies have examined the subsequent adjustment of [u] and other adjacent vowels such as [ɯ] and [ʌ] in a systematic manner (e.g., Kang 2014; Kang and Ryu 2015; Lee, Yoon and Byun 2016). These studies suggest that the ongoing change may involve broader system-wide reorganization; however, the extent to which such patterns are consistently observed across different elicitation contexts remains underexplored.

The contemporary SK has seven-monophthong vowels, namely [i], [ɛ], [ɯ], [ʌ], [o], [u], and [a] (Shin et al. 2012), after two historically distinct non-high front vowels, [e] and [æ] began to merge into [ɛ] around the early 1990s (Yeo 2022; Jeong 2022; Lee and Cho 2021; Eychenne and Jang 2015; Umeda 1999). Recently, another sound change has been reported in the SK back vowels, i.e., [o] and [u]. Since Chae (1999) originally documented an approximation between [o] and [u], several instrumental studies have shown that, from the 2000s onwards, the mid-back vowel [o] has risen to the phonetic territory of the high-back vowel [u], yielding the decreased distance between [o] and [u] (Jang and Shin 2007; Seong 2004; Han and Kang 2013).

The recurring pattern across the studies was that young and female speakers were ahead of older and male speakers in this ongoing approximation, a pattern often observed in cases of sound changes (e.g., Labov 2006). The Euclidean distance between [o] and [u] was smaller than previously reported (Seong 2004), and this reduction was particularly pronounced among female speakers in their 20s and 30s, whose acoustic vowel spaces showed substantial overlap between [o] and [u] due to the raising of [o] (Seong 2004; Jang and Shin 2007). Critically, Han and Kang (2013) showed that the Euclidean distance between the vowels [o] and [u] was progressively reduced in younger speakers in their 20s compared to older speakers in their 50s. These findings suggest that a language change may be underway in the SK back monophthong vowels. Recent studies have demonstrated that the raising of [o] is accompanied by the fronting of [u] and [ɯ], suggesting a system-wide reorganization of back vowels rather than a simple merger (Kang 2014; Kang and Ryu 2015; Kang and Kong 2016). However, despite this growing body of evidence for a chain shift in the SK back vowel system, the nature and extent of the change have not yet been systematically examined, particularly with respect to how adjacent vowels respond across different speech styles. Given the robust findings that [o] is being raised toward [u] in SK, particularly by young female adult speakers, we may expect two possible outcomes in the vowel system. On the one hand, the current situation may bring in a more widespread [o] raising over time, so that the phonological distinction between the two vowels is lost across generations of speakers, similar to what happened in the front vowels [e]- [æ]. An alternative outcome might be a chain-like shift of [u] to a new acoustic space, presumably to preserve the distinction (e.g., Gordon 2013). Earlier studies have documented the phonetic convergence of [o] and [u], with some interpreting it as an incipient merger (Han and Kang 2013) and others, such as Lee, Yoon and Byun (2016), highlighting it as part of a larger chain shift. While prior studies have laid important groundwork in documenting back-vowel approximation and reorganization, a systematic examination of how these patterns emerge across speech styles within the same speakers remains limited.

It is documented that speakers shift their production across speech styles. In careful speech, speakers may produce more standard or formal linguistic norms (Labov 1966, 1972, 2006) or represent the speakers' language ideology (Gafter 2016) eliciting what the speaker may consider 'correct' and more conservative speech form in a spoken community, because they are more likely to monitor their manner of pronunciation. In contrast, in conversational speech, speakers typically produce more vernacular style of speech and tend to be less cautious about their pronunciation while they are more dynamically interacting with their interlocutor. Relevant to the current study, it has been reported that sound change is realized more in conversational speech than in careful or formal speech (Eckert 2012; Labov 2010; Milroy and Milroy 1992). The speakers tend to produce certain pronunciation features or trends with their interlocutors, eliciting more innovative speech forms.

In contrast to laboratory-based read speech data (e.g., Han and Kang 2013; Jang et al. 2015; Seong 2004), spontaneous speech data from the Seoul Corpus (Yun et al. 2015) have suggested a more differentiated configuration of the back vowels. In these data, [u] remained distinct from [o], not primarily through vowel height (F1), but through advancement (F2), with [u] exhibiting greater fronting relative to [o] (Lee, Yoon and Byun 2016; Kang and Kong 2016). The corpus findings further revealed fronted realizations of [ɯ] and raised productions of [ʌ], pointing toward multidirectional adjustments within the vowel space. These patterns were especially robust among younger speakers.

Rather than indicating contradictory findings, the apparent differences between laboratory-based and corpus-based studies may reflect stylistic modulation of ongoing sound change. That is, merger-like overlap and chain-shift–like dispersion may surface differently depending on elicitation context. Because existing evidence for casual speech is largely limited to corpus data, a controlled within-speaker comparison of careful and conversational speech is necessary to clarify how stylistic variation conditions the restructuring of the Seoul Korean vowel system.

The present study examines whether [o]-raising in Seoul Korean constitutes a vowel chain shift by investigating its effects on adjacent vowels ([o], [u], [ɯ], and [ʌ]). Moving beyond aggregate analyses of large-scale corpora, this study adopts an individual-centered approach that traces how vowel systems are reorganized along a stylistic continuum as speakers shift from careful reading to spontaneous conversational speech. By focusing on within-speaker variation, the analysis captures dynamic adjustments in vowel realization that are likely to be obscured in population-level averages.

To provide a rigorous account of these stylistic shifts, we integrate normalized distance measures with Pillai–Bartlett trace scores (Nycz and Hall-Lew 2013). Whereas Euclidean distance indexes changes in the separation of vowel means, it does not capture distributional overlap. The Pillai score, by contrast, incorporates both variance and overlap between vowel categories, offering a more sensitive and statistically robust measure of phonetic distinctiveness within the vowel system.

Building on this perspective, the present study advances the view that merger-like overlap and chain-shift–like dispersion may represent complementary phonetic outcomes that coexist within the same speaker as a function of speech style. Under this account, [o]-raising may surface as increased acoustic overlap with [u] in more controlled or monitored speech, whereas [u]-fronting and subsequent adjustments of adjacent vowels may become more apparent in conversational speech that more closely approximates vernacular production.

To address this gap, the present study adopts a controlled within-speaker design, eliciting both careful read speech and conversational speech from the same cohort under identical recording conditions. In addition, we introduce the Pillai–Bartlett trace score as a quantitative index of vowel overlap. While this metric has been widely utilized in sociophonetic research to assess phonological mergers and shifts (Lee 2023;

Nycz and Hall-Lew 2013; Yu et al. 2024), it has not yet been systematically applied to the chain-shift dynamics of the Seoul Korean back-vowel system. By integrating Pillai scores with normalized distance measures, the present study evaluates individual-level stylistic shifts and examines how merger-like overlap and chain-shift–like dispersion co-occur across registers, offering a more granular account of the mechanisms driving ongoing vowel change in Seoul Korean.

We propose two research questions as follows.

1) To what extent does the [o]-raising influence the surrounding vowels ([u], [ɯ] and [ʌ]) in the acoustic vowel space?
2) To what extent are the SK vowels ([o], [u], [ɯ] and [ʌ]) produced differently in careful versus conversational speech? Based on the idea that conversational speech typically reflects more innovative varieties, what do these differences suggest about language change in the SK vowel system?

If the [o]-raising implies a merger with [u], the two vowels would completely overlap with little discrepancy between conversational and careful speech variants. If the [o]-raising implies a SK vowel chain shift, the move of [o] would subsequently influence phonemic space of other vowels, [u], [ɯ] and [ʌ]. If [u] moves to a more fronted position presumably to be differentiated from [o], the separation between [ɯ] and [u] may be smaller. Then, [ɯ] may move to either more fronted position or lowered position to be distinguished from [u]. With [o] raised, [ʌ] may drag up to fill the original mid-back position of [o]. We hypothesize that such a chain shift is more likely to be observed in conversational speech than in careful speech.

2. Methodology

2.1 Speakers

[1]Twenty-two SK speakers (16 females and 6 males) in their 20s were recruited at Hankuk University of Foreign Studies in Seoul and provided speech samples and

demographic information. They were all born and raised in Seoul and were on average 22.3 years old (SD = 3.1) at the time of data collection. None of the participants reported living abroad, nor speaking another language fluently. The participants were compensated for their time after the session was completed.

2.2 Materials, speech style conditions, and recording procedure

Each participant first carried out a reading task and then took part in an interview. In the reading task, they read eight isolated vowels ([i], [e], [æ], [ɯ], [u], [ʌ], [o], [a]) without preceding consonants. Isolated vowels were used to minimize coarticulatory effects from surrounding consonants. Potential onset glottalization was addressed by measuring formants at the temporal midpoint and by manually reviewing atypical tokens.

Each vowel appeared on a laptop screen in three randomized orders, and participants read each vowel aloud three times (24 tokens in total). Recordings were made using a lavalier microphone (Audio-Technica AT 899) connected to a Marantz PMD 670 recorder. The task took approximately five minutes.

Immediately following the reading task, each participant and the first author engaged in an interview task over approximately 45 minutes per participant, yielding sufficient conversational tokens for acoustic analysis. In this task, the interviewer and participant sat across from each other, and the same recording setup was employed. We adapted the interview prompts from the sociolinguistic interview questions outlined in Anastassiades et al. (2017)[1]. This task yielded speech that was naturally produced and conversational.

2.3 Tokens and measurement

Tokens of eight vowels—[i], [e], [æ], [ɯ], [u], [ʌ], [o], and [a] (including merged [e] and [æ] represented by distinct Hangul letters)—were identified and segmented from read and conversational tasks, including only tokens from content words with IP-initial target vowels in open syllables without coda. All the speech data were

1 While previous corpus-based studies typically sampled approximately ten speakers per age group, the current study includes 22 speakers in their twenties alone, allowing for a denser representation of a generation known to lead ongoing vowel change and for tighter control over stylistic variation.

manually transcribed, and vowel boundaries were also adjusted manually for accuracy. The first formants (F1) and second formants (F2) were measured at each vowel's midpoint, with atypical tokens manually reviewed and corrected. The total number of tokens is 4,329 (average token number per each vowel: N = 69 for the reading task; N = 472.1 for the conversation task, see the supplementary material for exact token counts per vowel). For [u], [o], [ɯ], and [ʌ], F1 and F2 values were extracted at the vowel midpoint.

2.4 Analyses

To standardize formant data for physiological differences such as vocal tract size, we applied Lobanov normalization (Kendall and Erik 2010) using the Vowel package in R (R Core Team 2023).

Our analysis focused specifically on three vowel pairs, i.e., [o]-[u], [o]-[ʌ], and [ɯ]-[u] and their positioning in vowel space across speech styles. Two primary statistical analyses were conducted for each pair: Pillai-Bartlett statistics and mixed-effects linear regression modeling. Pillai scores were calculated as a standard metric for vowel merger quantifying overlap between vowel distributions, through Multivariate Analysis of Variance (MANOVA) applied to F1 and F2 (Nycz and Hall-Lew 2013; Hall-Lew 2010). Pillai scores range from 0 (complete merger) to 1 (fully distinct vowel categories). Next, we ran mixed-effects linear regression models for the three vowel pairs ([o]-[u], [ʌ]-[o], and [ɯ]-[u]) to examine how the vowel categories are distributed along each formant value (F1 and F2). The fixed effect variables included VowelType (dummy coded with [o], [ɯ], and [o] as reference level for [o]-[u], [ɯ]-[u], and [ʌ]-[o] pairs, respectively), SpeechCondition (Careful as the reference level), and interactions between VowelType and SpeechCondition. The models specified speakers as random effect by including by-Speaker random intercepts and random slopes for VowelType and SpeechCondition, with slopes and intercepts uncorrelated to facilitate model convergence. F1 and F2 Models are summarized below. Both Pillai scores and regression analyses were conducted in R using the packages manova (Tabachnick and Fidell 2019) and lme4 (Bates, Maechler, Bolker and Walker 2015; Baayen et al. 2008), respectively.

Initially, the models included the place of articulation (PoA) and manner of articulation (MoA) of the prevocalic consonants as both fixed and random effects. Model comparison based on AIC and multimodel inference (Burnham and Anderson 2002; Barth and Kapatsinski 2017; Kuperman and Bresnan 2012) indicated that the contributions of PoA and MoA were marginal. Specifically, the posterior model probability dropped sharply from 32% for the best-fitting model to 3% for the next-best model when PoA and MoA were retained, suggesting limited explanatory gain from these predictors. Therefore, PoA and MoA were excluded from the final analyses in favor of a more parsimonious model.

Based on this model selection procedure, Models (1) and (2) represent the final best-fitting mixed-effects models used to analyze F1 and F2, respectively. Both models include fixed effects of VowelType, SpeechCondition, and their interaction, with by-speaker random intercepts and random slopes for VowelType and SpeechCondition.[2] Detailed model selection results, including the best-fit models and model-averaged coefficients, are available on the supplementary materials.

(1) F1 Model: F1~ VowelType*SpeechCondition + (1+VowelType + SpeechCondition |Speaker)
(2) F2 Model: F2~ VowelType*SpeechCondition + (1+VowelType + SpeechCondition |Speaker)

Besides the two major analyses, we calculated normalized F2 distances among vowels [ɯ]-[u]-[o] and normalized F1 distances among vowels [o]-[ʌ]-[a] to control for potential vowel-space reductions in conversational speech (Meunier and Espesser 2011; Kuo and Weismer 2016). Normalized F2 distance for [ɯ]-[u] was defined as the ratio of the F2 difference between [ɯ]-[u] to the F2 difference between [ɯ]-[o]. Similarly, normalized F1 distance for [o]-[ʌ] was the ratio of the F1 difference between [o]-[ʌ] to the F1 difference between [ʌ]-[a]. This approach may ensure that observed vowel proximity differences between speech styles reflect true phonetic shifts rather than the artifacts of vowel space compression in conversational speech.

2 https://osf.io/msq4d/files/g2f8z

3. Results

Figure 1 displays the distribution of all monophthong vowels across careful and conversational conditions in the F2 by F1 space. Upon visual inspection, the conversational vowel space appears reduced compared to that of the careful speech condition, and the target vowels [ʌ], [o], [ɯ], and [u] show different distributions across the two speech styles. Specifically, [u] might be more fronted than [o] in conversational speech, having almost equal distance among [ɯ], [u], and [o]. Also, the vowel [ʌ] shows an approximation toward [o] in conversational speech, compared to careful speech. These observations were supported by Pillai scores and the regression models of the three vowel pairs, [o]-[u], [ɯ]-[u], and [ʌ]-[o].

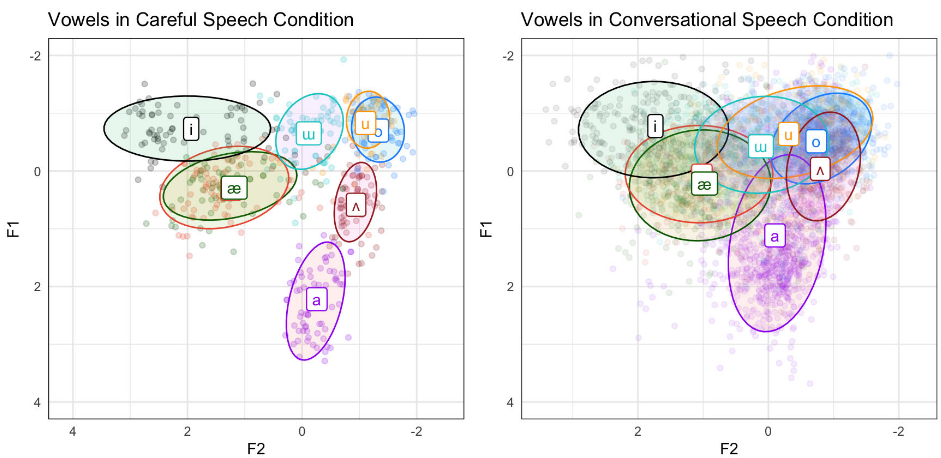

Figure 1. Distributions of normalized F1 and F2 for Korean vowels in careful versus conversational speech

3.1 Pillai scores

The Pillai score estimations suggested varying degrees of vowel overlaps across speech conditions (see Figure 2 and Table 1). First, the [o]-[u] pair showed similar Pillai scores close to zero in both speech conditions, suggesting a strong overlap of the vowels in both conditions (Figure 2.a and 2.b). Similarly, Pillai scores for the conversational [ɯ]–[u] pair were close to zero suggesting near-complete overlap, but those for the careful [ɯ]–[u] pair were far greater than zero i.e., 0.34. This indicates the vowels [ɯ] and [u] are well-separated in the careful speech differently from those in the conversational speech (see Figure 2.c and 2.d). Finally, Pillai scores of the [ʌ]–[o] pair showed the largest numerical discrepancy between the speech conditions with the scores of both speech styles not close to zero. The scores for the careful speech were greater than those for the conversational speech suggesting that the [ʌ]-[o] pair was distinguished more clearly in careful speech than in conversational speech (Figure 2.e and 2.f).

Table 1. Pillai scores for the three target vowel pairs in careful and conversational speech conditions: [o]-[u], [ɯ]-[u], and [ʌ]-[o]

Vowel Pair	Careful Speech	Conversational Speech
[o]-[u]	0.084	0.067
[ɯ]-[u]	0.34	0.08
[ʌ]-[o]	0.7	0.14

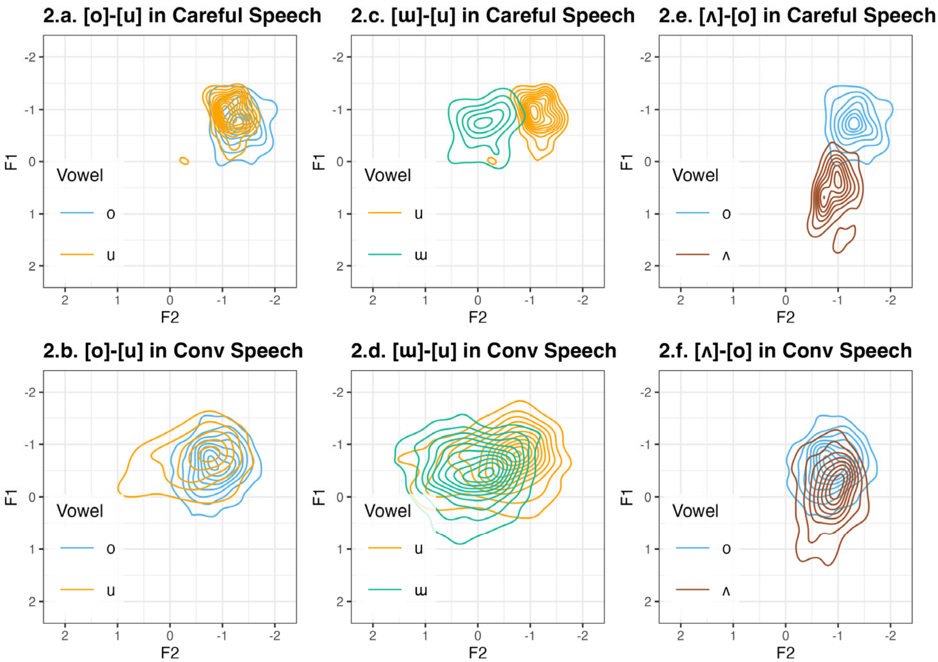

Figure 2. Contour plots for the three vowel pairs in careful and conversational (Conv) speech conditions: [o]-[u], [ɯ]-[u], and [ʌ]-[o]

3.2 Mixed-effects regression model results

3.2.1. [o]-[u] contrast

Table 2 presents the results of the mixed-effects regression models comparing [o] and [u] along the F1 and F2 dimensions. In the F1 model (Table 2a), VowelType was not a significant fixed effect, indicating no reliable overall difference in vowel height between [o] and [u]. In contrast, the F2 model (Table 2b) showed a significant effect of VowelType, with [u] produced with a significantly more fronted tongue position than [o].

SpeechCondition was a significant predictor in both models. Conversational speech yielded significantly higher F1 and F2 values than careful speech, indicating that both vowels were produced with a lower and more fronted tongue position in conversational speech. Importantly, the interaction between VowelType and SpeechCondition was not significant in the F1 model and only marginally significant in the F2 model ($p = .056$), suggesting that the relative height and frontness contrast between [o] and [u] remained largely stable across speech conditions.

Table 2. Result summary of (a) F1 Models and (b) F2 Models for the [o]-[u] contrast: with [o] as the reference level and careful speech as the reference condition. Bold indicates $p < 0.05$.

(a) F1 Models				
Predictors	Estimates	SE	p	Sig.
(Intercept)	-0.69	0.07	< **.001**	***
VowelType ([u])	-0.13 (0.09)	0.09	= .149	
SpeechCondition (Conversational)	0.18 (0.07)	0.07	**= .010**	*
VowelType x SpeechCondition	0.01 (0.10)	0.10	= .920	

(b) F2 Models				
Predictors	Estimates	SE	p	Sig.
(Intercept)	-1.33	0.08	< **.001**	***
VowelType ([u])	0.22	0.11	**= .046**	*
SpeechCondition (Conversational)	0.60	0.08	< **.001**	***
VowelType x SpeechCondition	0.21	0.11	= .056	.

3.2.2. [ɯ]-[u] contrast

Table 3 presents the results from F1 Model and F2 Model for the [ɯ]-[u] pair. Similar to the [o]-[u] results, SpeechCondition was a significant fixed effect in both models, indicating that vowels in conversational speech were produced with a lower and more fronted tongue position.

In the F1 model (Table 3a), neither the main effect of VowelType nor its interaction with SpeechCondition reached significance, indicating comparable vowel height across conditions.

On the other hand, F2 model (Table 3b) estimated a significant VowelType effect, showing that the [u] vowels in careful speech are produced with a more back tongue position than the [ɯ] vowels. The interaction term of VowelType with SpeechCondition was also significant, reflecting that [u] is less back in conversational speech.

Post-hoc t-tests with Tukey's HSD pairwise comparisons were conducted to further estimate F2 differences between [u] and [ɯ] in the two speech styles. These analyses revealed that the F2 difference was significantly smaller in conversational speech (ß = 0.58, SE = 0.12, $p < 0.0001$), although [u] remained significantly more back than [ɯ] in both conditions.

Because it is not clear whether the notably closer [ɯ]-[u] F2 distance in conversational speech is suggestive of a [u]-fronting or a proportional distance reduction inherent in an overall vowel space shrink in casual speech, we compared the normalized F2 distance of [u]-[ɯ] with that of [ɯ]-[o] in both speech styles. When individual speakers' normalized distances of careful [ɯ]-[u] are distributed against those of conversational [ɯ]-[u] (Figure 3), it was observed that most data points (17 out of 22 speakers) positioned above the diagonal line (i.e., the $y = x$ reference line, where normalized distances are equal across speech styles). Points above this line indicate that the normalized [ɯ]-[u] distance is shorter in conversational speech than in careful speech. That is, the closer distance of conversational [ɯ]-[u] on a normalized scale may confirm the phonetic shift of [u]-fronting in conversational speech.

Table 3. Result summary of (a) F1 Models and (b) F2 Models for the [ɯ]-[u] contrast, with [ɯ] as the reference level and careful speech as the reference condition. Bold indicates p<0.05.

(a) F1 Models				
Predictors	Estimates	SE	p	Sig.
(Intercept)	-0.65	0.07	< **.001**	***
VowelType ([u])	-0.18	0.09	= .046	*
SpeechCondition (Conversational)	0.23	0.07	**= .001**	**
VowelType x SpeechCondition	-0.04	0.10	= .689	

(b) F2 Models				
Predictors	Estimates	SE	p	Sig.
(Intercept)	-0.12	0.08	= .134	
VowelType ([u])	-0.98	0.12	< **.001**	***
SpeechCondition (Conversational)	0.23	0.09	**= .011**	*
VowelType x SpeechCondition	0.58	0.12	< **.001**	***

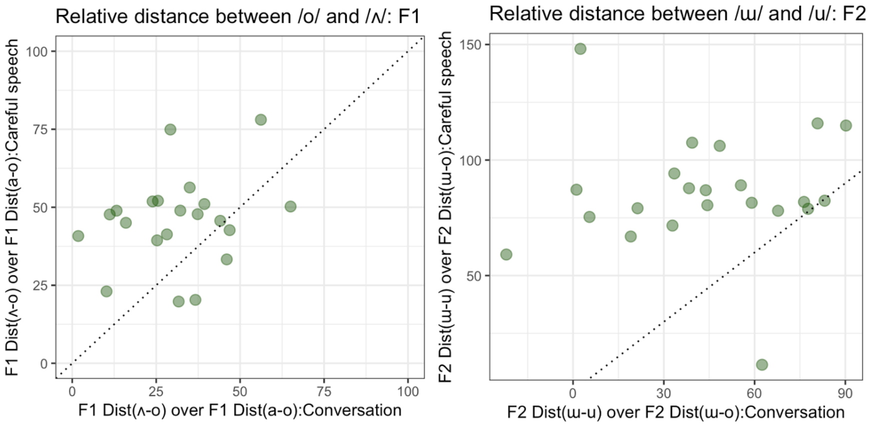

Figure 3. Normalized Distance between the vowel pairs: F1 distance of [ʌ]-[o] (right panel) and F2 distance of [ɯ]-[u] (left panel)

3.2.3. [ʌ]-[o] contrast

Table 4 summarizes the F1 and F2 model results for the [ʌ]-[o] vowel pair. As with the other pairs, SpeechCondition had a significant effect in both models, indicating a general tendency for lower and more fronted vowel production in conversational speech.

In both F1 and F2 models (Table 4a and 4b), VowelType was significant. Compared to [o], [ʌ] was produced with a lower and more fronted tongue position in careful speech. The interaction between VowelType and SpeechCondition was also significant in both models. Post-hoc pairwise comparisons revealed that the acoustic distance between [ʌ] and [o] significantly decreased in conversational speech compared to careful speech (F1: ß = −0.80, SE = 0.10, $p < 0.0001$; F2: ß = −0.45, SE = 0.09, $p < 0.0001$).

To examine whether or not conversational [ʌ] is seemingly closer to [o] because of a general compression of the conversational vowel space, we calculated the normalized F1 distance between [ʌ] and [o], using the [o]-[a] distance as a reference scale.

When individual speakers' normalized [ʌ]-[o] distances in conversational speech were plotted against those in careful speech (Figure 3), most data points (17 out of 22) were located above the diagonal line (the y = x line), indicating shorter normalized [ʌ]-[o] distances in conversational speech than in careful speech. These findings suggest that the reduced F1 distances between [ʌ] and [o] in conversational speech are not merely due to global vowel space reduction, but rather reflect a phonetic shift—specifically, [ʌ]-raising.

Table 4. Result summary of (a) F1 Models and (b) F2 Models for the [ʌ]-[o] contrast, with [o] as the reference level and careful speech as the reference condition. Bold indicates $p < 0.05$.

(a) F1 Models				
Predictors	Estimates	SE	p	Sig.
(Intercept)	-0.69	0.07	< **.001**	***
VowelType ([ʌ])	-1.28	0.1	< **.001**	***
SpeechCondition (Conversational)	0.17	0.07	= **.015**	*
VowelType x SpeechCondition	-0.80	0.1	< **.001**	***

(b) F2 Models				
Predictors	Estimates	SE	p	Sig.
(Intercept)	-1.32	0.06	< **.001**	***
VowelType ([ʌ])	0.39	0.08	< **.001**	***

SpeechCondition (Conversational)	0.59	0.06	< **.001**	***
VowelType x SpeechCondition	-0.45	0.09	< **.001**	***

4. Discussion

The current study investigated the careful and conversational variants of the SK vowel acoustics to understand whether and to what extent the SK non-front vowels are undergoing a sound change of a chain shift or of a local merger. Our analyses of the three vowel pairs—[o]-[u], [ɯ]-[u], and [ʌ]-[o]—provided supporting evidence for a systematic vowel shift, as the observed changes in vowel distributions were global across the target vowels. Specifically, [o] and [u] vowels were consistently distinguished in both careful and conversational speech conditions, which refines earlier interpretations that framed this pair as a possible merger (e.g., Jang et al. 2015; Han and Kang 2013; Jang and Shin 2006; Seong 2004; Yang 1996). Acoustic evidence of two other vowel shifts was observed in the [ɯ]-[u] and [ʌ]-[o] pairs when the acoustic spaces in conversational and careful speech compared: [u]-fronting and [ʌ]-raising. Casual speech typically exhibits reduced vowel space, leading to smaller acoustic distances between certain vowel pairs. In our data, [ɯ] and [u] were closer in F2 (backness) in conversational speech than in careful speech, and [ʌ] and [o] were closer in F1 (height), indicating ongoing shifts of [u]-fronting and [ʌ]-raising. Given that conversational speech often reflects more innovative variants and tends to lead sound change (Eckert 2012; Labov 2010), the comparison across careful and conversational speech offers a real-time snapshot of vowel change in progress in Seoul Korean. Importantly, these findings are broadly consistent with previous corpus-based and experimental studies that have reported coordinated movements of back vowels (e.g., Kang 2014; Kang and Ryu 2015; Kang and Kong 2016; Lee, Yoon and Byun 2016), while offering a more fine-grained within-speaker perspective on how such restructuring unfolds across speech styles.

The two notable shift patterns of [u] and [ʌ] in conversational speech can be attributed to the widely attested [o]-raising in Seoul Korean, as well as to subsequent adjustments aimed at maintaining phonological contrast within the vowel system. While [u] was still acoustically distinct from [ɯ] and [o] along the F2 dimension, the [u]–[ɯ] distinction was attenuated and the [u]–[o] distinction strengthened in conversational speech compared with careful speech. Additionally, the conversational [ʌ] vowel was higher and thus closer to [o] than the careful variants. The direction of the [u] and [ʌ] movements may suggest that the [u]-fronting is underway to maintain a contrast with [o], and the [ʌ]-raising to fill the acoustic space of mid-back vowel that [o] has left through its raising. Together, the current findings suggest that the impact of [o]-raising is not just limited to [u] but is present widely over the neighboring vowels [ɯ] and [ʌ], resulting in a global chain-like shift in the SK vowel system.

Figure 4 visualizes the progression of SK vowel changes by schematically comparing F1–F2 mean distributions from the current study (right panel) with those reported in previous literature (left panel; Yang 1996 [Table 4, p. 251]; Han and Kang 2013 [Figure 2, p. 29]; Jang et al. 2015 [Table 7, p. 350]). This comparison illustrates how the vowel system has shifted over time and highlights the patterns emerging in more recent data. While the acoustic distance between [o] and [u] remains similarly narrow in both vowel-spaces panels, [u] is more advanced in the current set of vowel data, differentiated from [o] along the F2 dimension (right panel). Also, the [u] vowels further shift toward a more fronted position closer to [ɯ], yielding a more crowded landscape of SK high vowels in the current study than in the previous studies. This difference of [u] distributions relative to [o] and [ɯ] between Yang (1996)'s vowel space and the current one supports the claim that the [o]-raising has not been developing to merge with [u] but to push it forward as the sound change progresses. Rather than contradicting earlier findings, the present configuration appears to extend previously documented patterns of [o]-raising and [u]-fronting into a more advanced stage of system-wide reorganization.

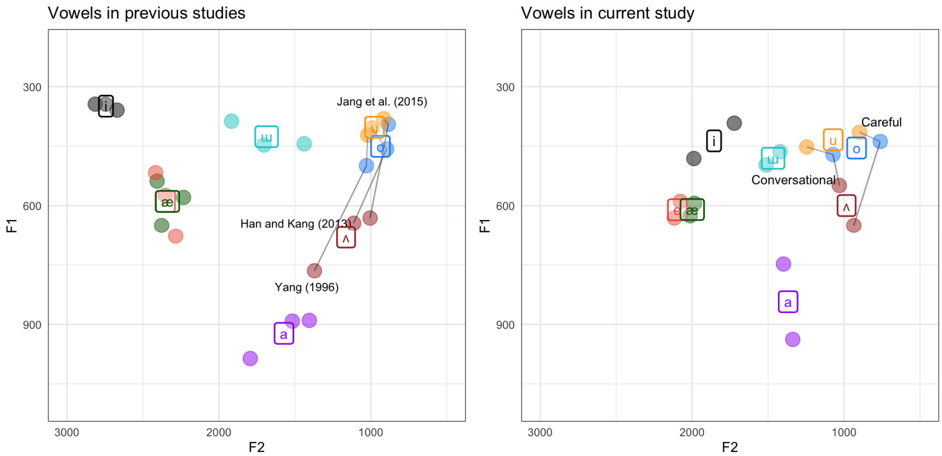

Figure 4. Vowel charts plotting raw mean F1 and F2 values for young female speakers from the three previous studies investigating the [u] – [o] contrast (left panel), and from the current study (right panel).

Placing the present findings in the broader diachronic context of Seoul Korean vowel change, the observed restructuring of the non-front vowels appears to follow earlier major changes in the front vowel system over the past several decades. These include the diphthongization of the high front rounded vowels [y] and [ø] into [wi] and [we], as well as the merger of the mid front vowels [e] and [æ] into [ɛ]. Viewed against this backdrop, the current results suggest that [o]-raising is not an isolated development but part of a broader, system-wide reorganization of the Seoul Korean vowel space.

It should be noted, however, that the present analysis is based on acoustic data from young Seoul Korean speakers. Future research is therefore needed to assess the prevalence and robustness of these shift patterns across a wider age range and across different segments of the speech community. In addition, perception studies will be crucial for examining whether listeners exhibit confusion between the relevant vowel pairs and whether potential mismatches between production and perception emerge (Yun & Seong, 2013), which would further inform the phonological status of these ongoing changes. Taken together, the present findings highlight the Seoul Korean vowel system as one undergoing gradual yet systematic restructuring and underscore the need for longitudinal and cross-sectional approaches to fully capture the dynamics of this sound change in progress.

5. Conclusion

The current findings enlighten our understanding of the Seoul Korean vowel landscape as a system undergoing gradual but systematic restructuring, calling for further longitudinal and cross-sectional research. We investigated whether [o]-raising in Seoul Korean constitutes a vowel chain shift by examining the acoustic relationships among the non-front vowels [o], [u], [ɯ], and [ʌ]. Using a controlled within-speaker design, we compared careful read speech and conversational speech produced under identical recording conditions, allowing us to isolate speech-style effects while minimizing between-speaker and corpus-related variability.

Across three vowel pairs ([o]–[u], [ɯ]–[u], and [ʌ]–[o]), the results provide converging acoustic evidence for a systematic, chain-like restructuring of the Seoul Korean vowel system rather than a local merger. Although [o] and [u] remained acoustically distinct in both speech styles, conversational speech revealed coordinated shifts in adjacent vowels, including [u]-fronting and [ʌ]-raising. These patterns suggest that the well-documented raising of [o] has broader consequences for the organization of the vowel space, triggering adjustments in neighboring vowels to maintain phonological contrast.

Methodologically, this study demonstrates the value of combining normalized distance measures with Pillai–Bartlett trace scores to capture both mean separation and distributional overlap between vowel categories. This integrated approach enables a more sensitive assessment of phonetic distinctiveness and reveals how merger-like overlap and chain-shift–like dispersion can coexist within the same speaker across speech styles.

Taken together, the findings highlight the importance of speech style as a key locus for observing sound change in progress and provide new evidence that ongoing vowel change in Seoul Korean involves gradual but system-wide reorganization. By foregrounding individual-level stylistic variation, this study contributes to a more nuanced understanding of vowel chain shifts and the mechanisms that drive phonological change. In doing so, the present study complements and extends earlier accounts of Seoul Korean vowel change, demonstrating how chain-like restructuring can be observed within the same speakers across speech styles.

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