/o/! They're j/u/st about the same!
Vowel Shift in Heritage and Homeland Seoul Korean

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1 Introduction

Heritage speakers are often compared to homeland speakers or second language learners to investigate the effects of the amount and type of input on language acquisition (Scontras et al. 2015, Montrul and Polinsky 2021). Heritage speakers are often defined as bilinguals who use their L1 primarily at home and their L2 outside the home as the community's majority language (following Chang 2021), although this frequently varies. In terms of phonology and phonetics, heritage speakers are of particular interest, as they show robust acquisition of the heritage and dominant languages' phonological systems (Montrul 2016, Chang et al. 2011, Polinsky 2018, Chang 2021), but vary in how much they participate in homeland language changes, such as vowel reduction.

This paper investigates the participation of Heritage Korean speakers in two homeland vowel shifts, namely /o/-raising and /u/-fronting, where /o/ is realized with lower first formant (F1) values (Kong and Kang 2018) and /u/ is advancing in the second formant (F2) dimension (Denis et al. 2013). While /u/-fronting is described as occurring in both Seoul Korean (Kang 2016, Kong and Kang 2018) and Toronto English (Denis et al. 2013, Hoffman 2016), only Seoul Korean is described as participating in /o/-raising (Kong and Kang 2018). This contrast allows comparison of the effect of input from the two languages on Heritage Korean production.

2 Background

In the existing literature, it has been reported that heritage speakers distinguish their productions of similar vowels in separate language inventories, maintaining phonetic contrasts in the first formant (F1) and second formant (F2), similar to homeland speakers. For example, Mandarin and English share the back round vowel categories /o/ and /u/; Heritage Mandarin speakers retain the cross-linguistic contrast between these vowels by producing /o^{u}, u/ with a lower F2 in Mandarin and with a higher F2 in English (Chang et al. 2011). In contrast, other studies have observed that heritage speakers may not fully distinguish between the F1 and F2 of similar vowels in their heritage language and English. Heritage Western Armenian speakers in California are reported to have an English influence on the F1 and F2 realization of the Western Armenian /i ɛ a/ (Godson 2004). This is attributed to the amount of English input received in childhood. These studies directly compare homeland and heritage speakers' productions to identify if there is interference from the community's majority language on the heritage speaker's phonological systems.

However, there are cases where the homeland speakers' phonological systems are changing. Heritage speakers participate in some but not all sound shifts present in homeland speech. For example, Cantonese heritage speakers in Toronto participate in some vowel shifts occurring in Hong Kong, namely [y] retraction and [i] fronting, but do not exhibit [ɪ, ʊ, ɔ] backing or [ɔ] fronting (Tse 2019). Heritage and homeland speakers also show variation in which social cues predict vowel shifting: age is a significant predictor for these changes in homeland speakers, but generation rather than age is a significant predictor for [y] retraction among heritage speakers (Tse 2019). In his study, there was no need to address the potential conflicting influence of the relevant majority language, as none of these vowel processes are attested in English.

Heritage speakers may also pattern differently from homeland speakers regarding the direction and degree of other sound changes. In Seoul Korean, homeland speakers are currently reweighting the cues used to distinguish aspirated and lenis stops, which used to be predominately determined

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by the voice onset time (VOT). Now, homeland speakers are increasingly using the F0 of the following vowel as the primary cue (Kang and Han 2013, Kang 2014). Heritage Korean speakers in the Greater Toronto Area (GTA) are potentially slowing the VOT merger and do not show the same sex-based contrast in advancing the change as homeland speakers do (Kang and Nagy 2016). Instead, female Heritage speakers are leading a change in the reverse direction, maintaining the VOT contrast (Kang and Nagy 2016). This change is attributed to English influence, as VOT is the salient cue used to differentiate voicing in English stop contrasts (Liberman et al. 1961, Lisker 1986).

These cases of heritage language participation involve situations where the heritage language is undergoing a sound change that is not present in the community's dominant language; however, in cases where both the heritage and majority language are undergoing similar shifts, it becomes more difficult to discern the source of the heritage speaker's grammar. Heritage Korean speakers in California have a high F2 for Korean /u/, which is attributed to the influence of California English (Cheng 2019). However, Seoul Korean is undergoing a vowel shift with /o/-raising and /u/-fronting, which may have also contributed to the Heritage Korean speakers' vowel production (Cheng 2021). Since both input languages are described as having /u/-fronting, ascribing the heritage speakers' high F2 for /u/ to English interference does not fully account for the speakers' vowel realizations. Instead, the high F2 of /u/ for heritage speakers may be due to English input, Korean input, or both.

This study aims to answer the following questions: If both input languages are described as undergoing a similar sound change, is there a way to differentiate each language's effect on a heritage speaker's participation in an observed homeland sound change in their heritage language? What methods can be used to tease apart the effects of each language on a speaker's phonological system?

To answer these questions, I investigated Heritage Korean speakers in the GTA and their participation in this vowel shift in their heritage language, Seoul Korean. For this particular context, the majority language spoken in Toronto is the variety of English known as Multicultural Toronto English, abbreviated as MTE (Denis et al. 2013). While both Seoul Korean and MTE's vowel systems are undergoing /u/-fronting (Kang 2016, Kong and Kang 2016, Denis et al. 2013, Hoffman 2016), only Seoul Korean is undergoing /o/-raising (Kong and Kang 2018). These two variables allow a comparison between shared and unshared sound patterns across two languages and how these affect the vowel realizations of heritage speakers. This study compares the effects of both linguistic and social factors that affect /o/-raising and /u/-fronting in both heritage and homeland populations as a method of investigating the degree of English or Korean influence on Heritage Korean grammars.

The relationship between /o/-raising and /u/-raising is alternately described as a shift or merger between vowels (Han and Kang 2013, Kang 2016, Kong and Kang 2018). This vowel shift appears to have begun in the 1990s and 2000s. In the 1990s, the primary distinction between /o/ and /u/ was F1 (Yang 1996), but in the 2000s, the primary cue was F1 for male speakers but F2 for female speakers (Moon 2007). The vowel system exhibits age-based variation, where younger speakers are described as having greater degrees of /o/-raising and /u/-fronting than older speakers (Kang 2016, Kang and Han 2013). Younger female speakers are described as leading this change, beginning with /o/ raising (Han and Kang 2013). In general, younger speakers of both genders are using F1 less to distinguish /o/ and /u/ and instead using F2 as the primary cue (Kang and Han 2013, Kong and Kang 2018).

Similarly, /u/-fronting in MTE is affected by gender, with younger female speakers advancing the change (Denis et al. 2013, Hoffman 2016). Ethnicity appears to be a conditioning factor, as Hoffman (2016) reports consistent /u/-fronting in speakers of Chinese, Anglo, and Portuguese descent, and Umbal (2021) finds that the Filipino community in Toronto fronts /u/ more than Anglo Canadians do. In addition, alignment toward older immigrant groups can affect the degree of /u/-fronting, as younger Italian male speakers are found to exhibit less fronting of back vowels to resist association with the mainstream sound shift (Hoffman 2016). For linguistic factors, /u/-fronting is licensed primarily in post-coronal contexts and is blocked in pre-lateral contexts (Denis et al. 2013, Hall and Maddeaux 2020).

3 Methods

Vowel production data is from the Heritage Language Documentation Corpus (Nagy 2009, 2011), which is composed of transcribed recordings elicited through the Heritage Language Variation and

Change in Toronto (HLVC) project. Of the corpus, 26 sociolinguistic interviews, conducted in Korean, were used as the source of spontaneous speech for the current analysis.

A varied set of speakers was selected from the HLVC to be a representative dataset for the study. Tested social factors include age, gender, generation, and ethnic orientation score. Heritage speakers were chosen to reflect a spread of ethnic orientation scores. Homeland speakers were then selected to match the age distribution of the sampled heritage speakers. The sample is summarized in Table 1.

Age (in Years)	Homeland	Generation 1	Generation 2	Total
Younger (15-29)	7	1	7	15
Middle (35-58)	2	4	1	7
Older (65-85)	1	3	0	4

Table 1: Homeland and Heritage Speaker Ages.

Three speaker groups were represented: Homeland, Generation 1, and Generation 2. Homeland speakers were born and raised in Seoul, South Korea. Heritage speakers are distinguished by generation. First generation speakers are originally from Seoul but moved to the GTA after the age of 18 and have remained in the GTA for at least twenty years. Second generation speakers have at least one first generation parent and were born in the GTA or arrived in the GTA before the age of 5. Speakers are not explicitly tested for language proficiency; instead, the language-based inclusion requirement is a speaker self-report that they are willing to converse for an hour in Korean. The 26 speakers represent a range of ages from younger speakers (15-29), middle-aged speakers (35-58), and older speakers (65-85). Since this phenomenon appears to be influenced by age, age was coded as a separate factor; however, due to the demographic requirements of heritage speakers, as described in the previous paragraph, age and generation are collinear factors.

Interviews were conducted by a fluent speaker of Korean, following the protocol for sociolinguistic interviews established in Labov (1984) and the HLVC questionnaire. A Zoom H4n digital recorder set to a 44.1 kHz sampling rate and Audio Technica lavalier microphone were used. Interviews were transcribed in Elan (Wittenburg et al. 2006) in Korean and English (for instances of code-switching) by research assistants.[1] Annotations were roughly segmented by sentence.

Based on the annotations created in Elan, recordings were chunked into sentence-level segments using Praat (Boersma and Weenink 2023). Next, the transcriptions and audio recordings were time-aligned at the segmental level using a Korean-specific forced alignment system (Yoon and Kang 2012). A Praat script was used to extract formants at five equidistant points from each segmented vowel using the 'To Format (burg)' method (Umbal and Schertz 2022). Only the durational midpoint measure was used in this analysis. Different formant ceilings were used to extract formants based on the speaker's gender and vowel quality. Male speakers were given a ceiling of 4,500 Hz for back vowels and 5,000 Hz for front vowels, while female speakers were given a ceiling of 5,000 Hz for back vowels and 5,500 Hz for front vowels. These processes yielded a total of 130,065 tokens across all speakers for all vowels, with 13,233 tokens of /o/ and 6,811 tokens of /u/. These tokens were then further processed in R (R Core Team 2023) to remove data errors and outliers, which were identified by converting vowel tokens to z-scores and removing all tokens that were more than two standard deviations away from the average from each speaker group (separated by gender). All tokens with undefined F1 and F2 values were removed. Tokens shorter than 5 ms were excluded to remove potential instances of vowel devoicing, while tokens longer than 200 ms were usually due to alignment errors and were therefore removed (Kang 2016). These steps removed 64,283 tokens (49% of all tokens). Lastly, tokens where the /o/ or /u/ vowel came from a code-switching component were removed, e.g., if a speaker used the English word 'Korean' during the interview. After these outliers were removed, the final data count is 5,919 tokens of /o/ and 2,460 tokens of /u/. Table 2 shows these vowel distributions by generation.

[1] This work would not have been possible without the tireless work of the HLVC Research Assistants. A full list of past research assistants can be found at: https://ngn.artsci.utoronto.ca/HLVC/3_3_former_ra.php. A list of the current research assistants is available here: https://ngn.artsci.utoronto.ca/HLVC/3_2_active_ra.php.

Generation	/o/	/u/
Homeland	3559	1385
Gen1	1421	600
Gen2	941	474
Total	5921	2459

Table 2: Number of Vowel Tokens by Generation and by Vowel.

Mixed effects models were constructed in R using Rbrul (Johnson 2009) to measure the effect of social and linguistic factors on the dependent variables. For the dependent variables, each speaker's average F1 for /a/ and average F2 for /a/ was subtracted from each measurement of that same speaker's F1 for /o/ and F2 for /u/. The vowel /a/ was chosen as an anchor as it is a low vowel not described as involved in any shifts and occurs in a consistent position across speakers. This results in the following two dependent variables:

1. Height of /o/ $F1_a - F1_o$ (Korean)
2. Frontness of /u/ $F2_a - F2_u$ (Korean and English)

Age was included as a factor to investigate whether age would have an effect in both heritage and homeland populations, or just the homeland group. Speakers were coded as one of three groups, Younger, Middle, or Older. Generation was coded as one of three levels (Homeland, Generation 1, and Generation 2). Gender was run as a binary variable and was based on participants' self-reported gender identity. Table 3 reports the distribution of speakers by gender and generation.

Gender	Homeland	Generation 1	Generation 2	Total
Female	5	4	4	13
Male	5	4	4	13

Table 3: Homeland and Heritage Speaker Gender Distributions.

The last social factors of interest are ethnic orientation scores. Two ethnic orientation scores were obtained from the Heritage speakers: one for language (EO-Language) and one for culture (EO-Culture). These values were calculated according to participant's responses to 37 questions of eight different topics in the Ethnic Orientation Questionnaire (EOQ) [2]. The first component, the EO-Language score, is based on questions that assessed their language preferences, language use with peers, and history of language education (Nagy, forthcoming, Petrosov and Nagy 2023). In contrast, the second component, the EO-Culture score, is based on a subset of questions that assessed their parents' and partners' ethnic orientation and language use and usage of the language with family members (Nagy, forthcoming, Petrosov and Nagy 2023). Heritage speakers with either very high or very low scores for either EO-Culture or EO-Language were selected to maximize the possibility of finding an effect. Ultimately, 26 speakers were selected out of 27 speakers under consideration, with one speaker removed due to the poor audio quality of their sociolinguistic interview. The range of scores for EO-Language was a minimum of -2.59 and a maximum of 2.81, while the range of scores for EO-Culture was a minimum of -1.61 and a maximum of 3.58.

These social factors across speaker groups can shed light on each language's effects on back vowel fronting and raising to see whether heritage speakers are reflecting more English-like or Korean-like trends in their vowel realizations. If there are shared social factors between heritage and homeland models that are not described as occurring in English, this is evidence that the source of the vowel shift is not due to English. However, if there are significant social factors in heritage speakers that are not significant in the homeland and are described as occurring in English, then this is evidence that the shift is due to the effects of English.

Linguistic factors under investigation include position in word, duration of the segment, and

[2]This questionnaire is available online at the following link: https://ngn.artsci.utoronto.ca/pdf/HLVC/long_questionnaire_English.pdf.

preceding place of articulation. These linguistic factors are used to compare the grammars of heritage and homeland speakers to determine whether the same factors are significant across generations and whether the significant patterns are in the same direction for each population. These expected effects are included in the models to identify the effects of the social factors which are used to test the hypotheses above.

Position in Word was coded as a binary variable: the relevant vowel either appears in a syllable that is word-initial or not-word-initial. This binary coding does not consider the number of syllables in a word or the presence of an onset in a CV sequence. For example, both of the /u/ tokens in [p**u**.tɯ.ɾʌp.kɛ] 'smoothly' and [**u**.san] 'umbrella' were coded as word-initial, even though one token is a CV sequence and the second token is a V syllable. Similarly, both of the /o/ tokens in [t̪a.r**o**] 'separately' and [nɛŋ.tsaŋ.k**o**ŋ] 'refrigerator' were coded as non-initial, even though one word has two syllables and the other word has three. Vowels in single-syllable words were coded as occurring in word-initial position, such as [tɕom] 'a little.'

Duration of the vowel token was the second linguistic factor, coded as a continuous variable. The last linguistic factor under investigation was place of articulation of the preceding consonant was coded to investigate positional effects that favour /o/-raising and /u/-fronting. Place of articulation was collapsed into four main groups: coronal (comprised of the phonemes /n/, /t/, / tʰ/, /t̪/, /s/, /s̪, /l/, / ɾ/, / tɕ/, /t̪ɕ/, /tɕʰ/), dorsal (/ŋ/, /k/, / kʰ/, /k̪/, /h/), vowel/word-initial (/i/, /ɛ/, /ɯ/, /u/, /o/, /ʌ/, /a/), and bilabial (/m/, /p/, /pʰ/, /p̪/). While not all phonemes in the dorsal category are produced with the back of the tongue, such as the voiceless glottal fricative /h/, the vowels tokens in these contexts patterned similarly and thus were collapsed into one category.

Lastly, Speaker was included as a random effect in all models to account for potential individual variation that may otherwise be masked under models with many speakers. Word (by-items) was not run as a random intercept due to the wide variety of words attested in the data and the low rate of repetition of many of them. Models tested the effects of the linguistic and social factors summarized in Table 4. The threshold for significance used in all models is a p-value less than 0.05.

Factor type	Factor	Levels
Social	Gender	Male Female
	Age	Younger Middle Older
	Generation	Homeland Generation 1 Generation 2
	EO-Language score	Continuous Low: -2.59 (more English oriented), High: +2.81 (more Korean oriented)
	EO-Culture score	Continuous Low: -1.61 (more Canada oriented), High: +3.58 (more Korea oriented)
Linguistic	Duration of vowel (ms)	Continuous
	Position in Word	Non-Initial *dda.r**o*** 'separately' *eo.sin.m**u**n* 'foreign language newspaper' Initial ***u**.san* 'umbrella' *d**o**.eum* 'assistance'
Random	Speaker	Speaker codes, e.g., K1F85A

Table 4: Summary of Predictors Tested.

Step-up/step-down models were first run in R using Rbrul (Johnson 2009) to identify the best-fitting model that contained the smallest number of factors that accounted for the most variation in the data, examining each generation separately. Rbrul creates step-up and step-down models by identifying the factor that has the greatest effect on the variable being tested, and then adding (in the case of step-up) or removing (in the case of step-down) factors one at a time until only significant factors are included in the model (Johnson 2009).

Additionally, two versions of the step-up/step-down models that differed only in including either Age or Generation were then run, as these are collinear factors that must not be included in the same model. The Akaike Information Criterion (AIC) value was used to compare these two models, as this value reflects how accurately modeled effects match the attested effects of each factor (Symonds and Moussalli 2010). Models were selected as optimal if they include the lowest AIC without any mismatch in ranking of levels by coefficient and average value. The best model, according to these criteria, is reported and discussed for each of the three dependent variables.

4 Results

To investigate each vowel's potential direction of change and the factors that condition variation, mixed-effects linear regression models were constructed for the relevant formant. The models investigating the F1 of /o/ are presented in this section using $F1_a - F1_o$ as the dependent variable. As /a/ is a lower vowel than /o/, all values are positive. In speakers whose /o/ is raised more, the distance between /a/ and /o/ will be larger compared to speakers whose /o/ is raised less.

A summary of all conducted mixed-effects models for /o/-raising is presented in Table 5. Homeland speakers and Generation 1 speakers share only one significant predictor, Position in Word, while Homeland and Generation 2 speakers only share Gender as a significant factor. The comparison between the shared linguistic factor (Position in Word) and social factor (Gender) can be interpreted as differences in speakers' grammars. Both factors pattern similarly in their respective heritage model to the homeland model – non-initial tokens show more /o/-raising than initial tokens for both Generation 1 and Homeland speakers, and female speakers exhibit more /o/-raising than male speakers for both Generation 2 and Homeland speakers. This finding provides a baseline to which other variables (/u/-fronting) can be compared, as there is potential for English influence for those processes (while o-raising is not attested in Toronto English).

While Generation 1 speakers and Homeland speakers both have Position of Word as a shared linguistic factor, the factor does not have an equal effect size in both models. While it is the factor with the greatest range for Generation 1 speakers, Gender has a greater effect in predicting /o/-raising for Homeland speakers. This pattern is reflected in Generation 2 speakers, where Gender has the largest range and therefore the largest effect across significant factors.

There are also two significant factors examined in the heritage models that are not relevant in the homeland model. EO-Language is a significant factor for Generation 1 speakers, where an increase in the score (more Korean-oriented) corresponds to an increase in /o/-raising. This pattern is attested for Generation 2 speakers, although the effect is not significant ($p = 0.06$) and thus not included in the table. This finding suggests that the amount of input that heritage speakers receive influences their participation in the sound change. Next, Preceding Place of Articulation is a significant factor only for Generation 2 speakers, where /o/-raising occurs the most when preceded by a bilabial segment and occurs the least when preceded by a coronal segment. This factor is not significant for either Generation 1 ($p = 0.21$) or Homeland ($p = 0.18$) models.

The next variable is the F2 of /u/ relative to /a/ ($F2_a - F2_u$ as the dependent variable), which investigates potential degrees of /u/-fronting. If /u/ is fronting, then the distance between /u/ and /a/ will decrease; if /u/ is not fronting, the distance between /u/ and /a/ will increase. A summary of significant factors across the models for $F2_a - F2_u$ is presented in Table 6. Homeland and Generation 1 models share more linguistic effects (Preceding Place of Articulation, Duration) and share no social effects. The opposite is true for Homeland and Generation 2 models, which share one social effect (Age) and no linguistic effects. The shared linguistic effects point to the similarities between Homeland and Generation 1's phonological grammars. The shared social factor between Homeland and Generation 2 speakers also points to the varied input that heritage speakers are receiving, which includes enough relevant social information for Generation 2 speakers to show similar age-based patterns as Homeland speakers. However, the unequal patterning of linguistic and social factors

suggest that these three speaker groups do not fully share a grammar and therefore are not one cohesive group.

Predictor	All Speakers	Homeland	Gen1	Gen2
n	5919	1385	1421	941
Gender	✓****	✓****		✓****
Position in Word	✓***	✓***	✓****	
Preceding Place of Articulation				✓***
EO-Language	n/a	n/a	✓***	
Duration				
Age				
EO-Culture	n/a	n/a		
Generation		n/a	n/a	n/a

Table 5: Significant predictors (indicated with "✓") in MEMs investigating $F1_a$ – $F1_o$ (n = 5919), for each speaker group, with significant predictors ordered from greatest (indicated with ****) to weakest (indicated with a decrease in number of asterisks). Factors that are non-significant for all models are greyed out.

Predictor	All Speakers	Homeland	Gen1	Gen2
n	2459	1385	600	474
Preceding Place of Articulation	✓****	✓***	✓****	
Duration	✓**	✓*	✓***	
Age	✓***	✓****		✓****
Position in Word		✓**		
Gender				
EO-Language	n/a	n/a		
EO-Culture	n/a	n/a		
Generation		n/a	n/a	n/a

Table 6: Significant predictors (indicated with "✓") in MEMs investigating $F1_a$ – $F1_u$ (n = 2460), for each speaker group, with significant predictors ordered from greatest (indicated with ****) to weakest (indicated with a decrease in number of asterisks) and non-significant factors for all models greyed out.

5 Analysis

Based on the results presented in Section 4, Korean Heritage speakers participate in /o/-raising and /u/-fronting, with shared significant factors patterning in the same direction as Homeland Korean speakers. Thus, we can interpret the variable patterns as based on Korean influence and not affected by English. However, Korean Heritage speakers show varying levels of similarity to Homeland speakers, where some significant factors in the Homeland model are not shared in both Heritage models. Overall, the participation of heritage speakers in vowel shift is favoured by Korean input through significant factors that are attested in Korean but not in English, such as syllable-initial prominence effects and coarticulatory effects. The participation in the vowel shift does not appear to be from English interference, as there are no generational effects.

The shared linguistic factors offer evidence that Generation 1 speakers are /u/-fronting due to Korean input. Generation 1 speakers share Position in Word as a significant factor, where non-initial tokens exhibit more /o/-raising than initial tokens. Both patterns are unattested in English, particularly the existence of syllable-initial prominence effects (Cho and Keating 2009). These shared factors suggest that Generation 1 speakers receive enough Korean input to incorporate this into their

grammars, and the significance of EO-Language confirms this result. In contrast, Generation 2 does not share any linguistic factors with Homeland speakers. This finding is relatively surprising given that it is expected Generation 2 receives a large amount of input from Generation 1 speakers. The only linguistic factor that is significant for Generation 2 is favouring /u/-fronting in postcoronal contexts, which is a shared pattern across Korean and English. Since a female lead is a significant effect shared between Seoul Korean and Toronto English (Denis et al. 2013, Han and Kang 2013), it cannot be used as a diagnostic. This leaves Generation and Age as relevant social factors. If English were to be affecting heritage speakers' participation, I would expect to see Generational differences, with Generation 1 speakers participating less than Generation 2 speakers in the shift, based on Hoffman's (2016) report. However, if age is significant, this suggests that Korean has a greater influence on heritage speakers' participation, as age is associated with back vowel fronting in Korean.

Generation 1 speakers do not have any significant social factors in their model, but Age is significant in the Generation 2 model, where younger speakers exhibit more /u/-fronting than older speakers. This factor is shared with Homeland speakers, who show the same pattern. Generation was not included in the model as including Age better fit the data. Since Age better accounts for variation than Generation, this suggests that younger speakers (many of whom happen to be in Gen2 rather than Gen1, see Table 1) pattern more similarly to Homeland speakers. However, expected linguistic factors that affect /u/-fronting do not show up as significant or do not improve the model's fit to the data for Generation 2. As /u/-fronting is a more novel process (as reported for the Homeland variety), it may be that not all cues in homeland grammars have already been incorporated into heritage grammars. Gender is also a shared significant factor between Generation 2 and Homeland speakers, where female speakers exhibit more /o/-raising than male speakers. This finding differs from the VOT patterns in Heritage Korean, where female heritage speakers were reversing the change instead of advancing it (Kang and Nagy 2016). Instead, for /o/-raising, both female heritage and homeland speakers are leading the change in their respective speaker groups. Heritage speakers receive enough Korean input to incorporate the social conditioning of vowel changes in Korean.

Overall, Generation 2 speakers share more social factors with Homeland speakers than linguistic factors, and Generation 1 speakers share more linguistic than social factors. Unlike similar studies on sound shifts in heritage speakers (cf. Kang and Nagy 2016, Tse 2016, 2019), social factors in homeland speech are attested and pattern in the same direction in heritage speakers. This finding offers new insights into heritage language maintenance: Generation 2 Heritage Korean speakers have enough varied input to reflect both Age-based and Gender-based differences, while Generation 1 speakers show more robust patterns for linguistic effects.

The last social factor under consideration is ethnic orientation scores, which can show speaker alignment towards one language or another, reflecting the amount of input and therefore influence that a language has on a speaker's grammar. Ethnic orientation of the speaker can affect their participation in vowel shifts, where a stronger orientation towards Korean identity is associated with less participation in English sound shifts (Jeon 2017). Although two ethnic orientation scores were tested to investigate the direction of vowel change, they were not significant in most models. Two scores were used, EO-Language to compare the amount and type of a speaker's reported language use, and EO-Culture to investigate the speaker's cultural orientation. EO-Language was a significant factor for only one model, the F1 of /o/ in Generation 1 speakers. There, EO-Language has a positive association with /o/-raising, where a higher EO-Language score entails more /o/-raising. The significance of EO-Language confirms that heritage speakers are participating in /o/-raising as a result of Korean input and establishes a relationship between the amount of language input and the degree of participation in the sound change.

However, since EO-Language and EO-Culture are not significant in any other model, they do not provide additional insights as to which input language motivates back vowel fronting more in a speaker's grammar over the other. This finding is not unexpected, since both poles of EO-Language are associated with /u/-fronting. However, EO-Language does have an effect when the two poles have different vowel shift patterns, namely with /o/-raising. This is a testament to the relevance of ethnic orientation scores for heritage speakers' participation in vowel shifts, showing that there is an association between a speaker's identity and their phonological grammar.

6 Conclusion

This study investigated the participation of heritage Korean speakers in the GTA in two vowel shifts, /o/-raising and /u/-fronting. Back vowel fronting is an attested phenomenon in Toronto English, as well as in Homeland Korean, so it is unclear whether back vowel fronting occurs in heritage Korean speakers due to English or Korean influence. I use three diagnostics to tease apart the effects of each input language: linguistic factors, social factors, and the significance of two ethnic orientation scores.

I find that both Generation 1 and 2 speakers share significant linguistic and social similarities with homeland speakers that are not present in English. The shared direction of each pattern points to Korean influence being the source of heritage Korean speakers' back vowel shift. In conclusion, heritage speakers' participation in /o/-raising and /u/-fronting is due to Korean input rather than English influence. The lack of generational effects on vowel realizations and the number of shared social and linguistic factors across heritage and homeland models that are not attested in English further support the conclusion that the fronting is not contact-induced change.

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