Front vowel lowering in New Zealand English: investigating a regional sound change

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ABSTRACT

New Zealand English is often noted for its lack of regional variation. Recent research, however, has suggested young speakers in New Zealand's largest city Auckland might have lowered **DRESS**, **TRAP**, and **NURSE** vowels. In the following paper we report findings from a study investigating regional sound change. Auckland speakers were compared with New Zealand English speakers from a regional city, Nelson. Sociolinguistic interviews were recorded with 85 participants stratified by age (16-25 and 40+), gender, and location. Hand-corrected formants from over 25,000 monophthong tokens in stressed syllables, were analyzed. The results confirm earlier findings where young Aucklanders have lowered and retracted **DRESS**, **TRAP** and **NURSE** vowels. There is also some indication, however, that young Nelsonians might also be starting to participate in vowel lowering. The implication of these results is discussed.

Keywords: New Zealand English, Sound Change, Acoustic Analysis, Monophthongs, Vowels.

1. BACKGROUND

1.1 New Zealand English

In this analysis we focus on two ongoing vowel shifts that have been at the forefront of New Zealand English (NZE) phonetic research. The first is the short front vowel shift involving **DRESS**, **TRAP**, and **KIT**. New Zealand English research over the past 40 years has tracked the raising and fronting of **TRAP** and **DRESS** vowels [1, 2, 3]. This sound change has also resulted in the **KIT** vowel retracting and lowering. Studies such as [4] also show that the raising of **DRESS** has resulted in the diphthongization of the long vowel **FLEECE**. The second shift of interest is the raising of the **NURSE** vowel towards GOOSE [5]. Until recently NZE research has documented the continuation of these shifts [2, 3, 4, 6].

Recent phonetic analysis of young speakers in Auckland [7, 8], however, found **TRAP** and **DRESS** lowering, and reduced **FLEECE** diphthongization. This is significant as New Zealand English is generally considered to have little regional variation [9, 10]. If vowel raising is continuing outside Auckland then this could indicate the emergence of an Auckland based variety of NZE. The findings from this study were limited to read speech from young speakers, however. This meant the conclusions reached from this analysis are preliminary in nature.

1.2 Auckland (Urban) vs. Nelson (Regional)

In this paper we report findings from a study comparing monophthongs of speakers from two New Zealand regions. The first, Auckland, is New Zealand's largest city/urban area. It has a population of 1.5 million people, and since the early 1990s has been undergoing rapid demographic change, resulting in increased linguistic diversity compared to elsewhere in NZ. Although Statistics New Zealand does not collect data specifically about the number of New Zealand English speakers, we can show linguistic diversity through other metrics. For example, 41.6% of Aucklanders were born overseas (27.4% nationwide). In addition, 67.4% of Aucklanders speak only one language (77.7% nationwide) [11]. This is significant as studies done in the UK and Europe have suggested that linguistic diversity in large cities can be a catalyst for language change [12].

Our second region, Nelson-Tasman is located in the far north of New Zealand's South Island. It has seen demographic change at a slower pace than Auckland. It has a population of around 100,000, with the largest urban centre having a population of about 65,000 residents. In relation to Auckland, Nelson's population is more monolingual, with a higher proportion of New Zealand English speakers. 78.6% of Nelson-Tasman residents were born in New Zealand compared to 58% of Aucklanders. 87% of residents speak only one language (77.7% nationwide) [13, 14]. It is also important to note, about half of Nelson's migrant population are from the United Kingdom and Ireland. This starkly contrasts Auckland's immigrant population who are from a diverse range of countries across Asia, Europe, and the Pacific Islands. This has resulted in a population which is more like the demographics of New Zealand pre-1990.

2. METHODOLOGY

2.1 Speakers

This study uses data from two sources. Most of the data was collected for the Auckland Voices Project (for details see [7]). This database consists of 67 New Zealand English speakers from Auckland. For this analysis they are stratified by age (Under 25, and Over 40), and gender. An additional 18 recordings with New Zealand English speakers from Nelson were collected for this study, also stratified by age and gender. A breakdown of speakers is given in *Table 1.* Participants were all either New Zealand born or had arrived in New Zealand under the age of seven. Younger speakers had to have lived in their respective location for their entire time in New Zealand. Older Auckland speakers had to have lived in Auckland for 20+ years. Nelson speakers had to have lived in Nelson for 20+ years, and additionally could not have lived in Auckland for any extended period.

Table 1. *Speaker distribution by age, gender, and location.*

		Under-25	Over 40
Auckland	Women	20	17
	Men	18	12
Nelson	Women	5	5
	Men	3	5

Participants were recorded in sociolinguistic style interviews for 1-2 hours in a quiet location of their choice. Interviews were recorded on two devices. A Zoom H5 and a Marantz PMD 661, both using a TDK lavalier clip-on microphone. In instances where the main microphone failed, backup recording from the main recording devices were used. The speech signal was sampled at 44.1 kHz and quantized to 24 bit.

2.2 Data Preparation

In this analysis we took vowel tokens from a ten minute section of the larger interview. This section was taken at the 30-minute mark. This time point was selected as far enough into the interview for the speaker to be comfortable with the interviewer and recording device, but before the speaker was fatigued. Recordings were transcribed using ELAN [15] and passed through the forced aligner WebMAUS (NZ English service) [16]. Further processing was then done using the EMU-webApp [17]. Phonetic boundaries were hand checked and corrected where necessary. Formant tracks were calculated using forest within the EMUR [17] package in R [18]. These formants were then hand checked and corrected where necessary in the EMU-webApp. Additionally, stressed monophthongs were labelled at the vowel target based on the criteria given in [19 & 20]. The F1 and F2 values were then extracted at these vowel targets using EMUR in R. In total this analysis looks at 25,000 hand-labelled monophthongs tokens.

Preliminary investigations into this dataset showed that the impact of gender and aging on the vocal tract made it difficult to meaningfully compare group means. In most instances it would be beneficial to use speaker normalization such as Lobanov or Hearney [21] to minimize speaker differences. Our testing, however, found that, because the changes we are interested in largely involve high front vowels, normalization warped the vowel space towards the high front vowel space, and did a poor job of minimizing vocal tract differences while also retaining sociolinguistic differences. Instead, we use a modified version of the linear transformation performed in [8]. We perform two linear transformations on the F1 and F2 values of the dataset, using the anchor vowels **FLEECE**, **THOUGHT**, and **START** (the peripheral vowels of New Zealand English). The first transforms the male formant values towards the female speaker values. The second takes the transformed male to female formant values, stratifies them by age, and transforms the younger speakers towards the older speakers. Details and examples of this transformation process can be found in [8].

3. RESULTS

3.1 Visual Analysis

Figure 1. shows the results of the formant analysis. Our statistical analysis suggests no significant differences between men and women, therefore, in this instance for space reasons, we combine male and female groups. Centroid means are transformed formant values as described section 2.2. This allows us to combine male and female formant values in the visual analysis. All formant values are in bark. All four plots retain the characteristic triangular vowel space of New Zealand English, with centralized **START** and **STRUT** vowels. All four groups also have a fronted GOOSE, and a mid-back **LOT** vowel. Considering our four vowels of interest, it is worth noting that all four groups have the lowered and retracted **KIT** vowel that distinguishes NZE from Australian English. In addition, the two groups of speakers aged 40+ have raised **DRESS**, **TRAP** and **NURSE** vowels. The Auckland Under 25 group, however, have lowered and retracted **TRAP** and

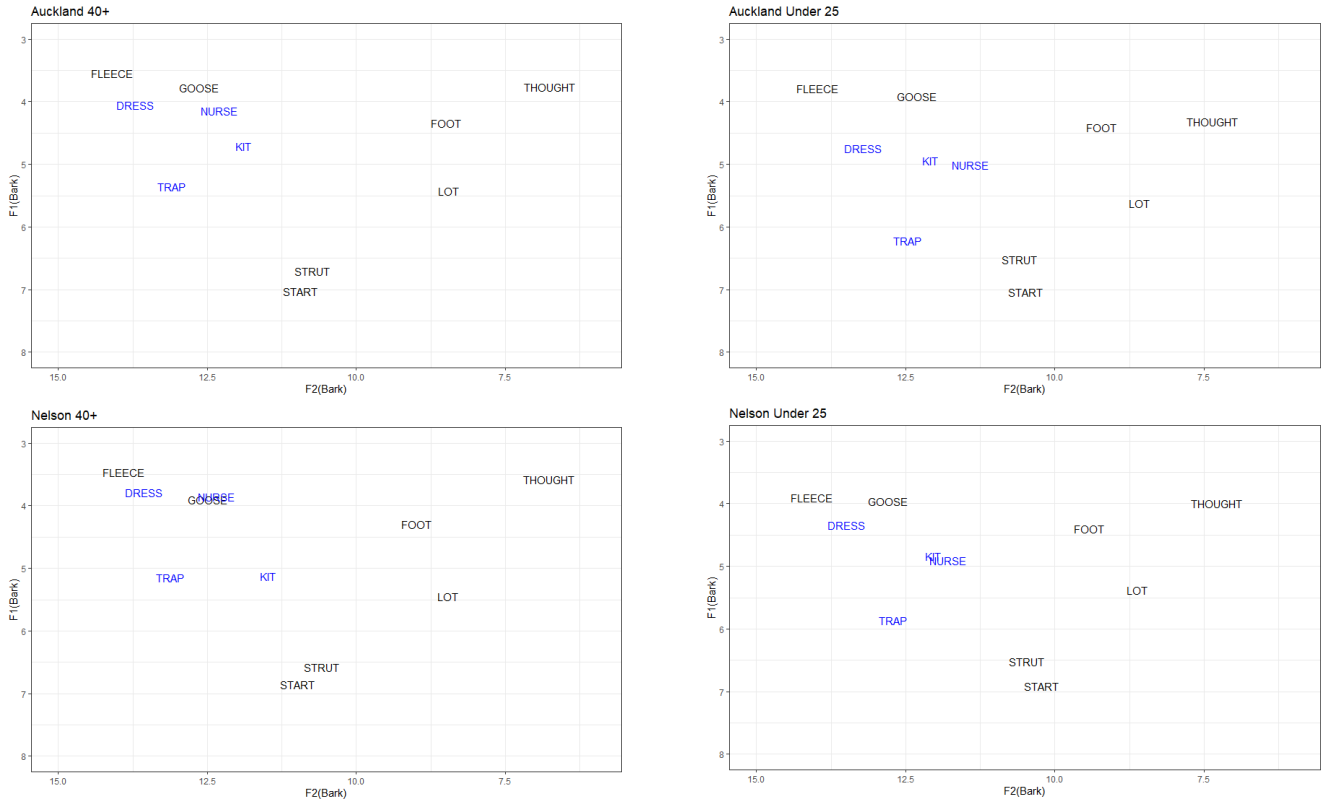

Figure 1: F1/F2 plots of all speaker groups monophthongs. Centroids are transformed means.

DRESS vowels. In addition, **NURSE** is lowered and retracted patterning with **KIT** rather than GOOSE. Interestingly, the visual analysis suggests the younger Nelson speakers retain a raised **DRESS** vowel, but have a lowered **NURSE** vowel and a somewhat lowered **TRAP** vowel compared to the Nelson 40+ group.

3.2 Statistical Analysis

We performed four statistical analyses on our vowels of interest (**DRESS**, **KIT**, **TRAP**, and **NURSE**), outlined in *Table 2,* to investigate whether the visual changes observed in *Figure 1* were significant. All analyses use linear mixed models performed in R, following the methodology in [8] and [22]. The models were calculated using `lme()` function in the `nlme` package. For each vowel three linear mixed models were built for observations of the first and second formants. Comparison between models was done with the `nlme` package using the `anova()` function. When each of the null models were compared by gender (Type vs. Sex) there were no significant differences at a significance level of 0.01. This suggests that gender differences in this dataset are negligible, and for space reasons these results will not be reported here.

Our first analysis (*Table 3*) looks at Auckland speakers to establish whether the vowel lowering identified in the visual analysis is significant. When

Table 2. *The four statistical analyses presented in this investigation.*

Model	Fixed Effects	Random Effects	Observation
Analysis1: Auckland 40+ vs. Auckland Under 25			
Null	Type	Speaker	Formant value
g1	Type*Age	Speaker	Formant value
g2	Type*Sex	Speaker	Formant value
Analysis 2: Auckland 40+ vs. Nelson 40+			
Null	Type	Speaker	Formant value
g1	Type*Place	Speaker	Formant value
g2	Type*Sex	Speaker	Formant value
Analysis 3: Nelson 40+ vs. Nelson Under 25			
Null	Type	Speaker	Formant value
g1	Type*Age	Speaker	Formant value
g2	Type*Sex	Speaker	Formant value
Analysis 4: Auckland Under 25 vs. Nelson Under 25			
Null	Type	Speaker	Formant value
g1	Type*Place	Speaker	Formant value
g2	Type*Sex	Speaker	Formant value

the null model was compared with g1 (Type*Age) **TRAP**, **DRESS**, and **NURSE** differed at a significance level of 0.01. Further analysis from post-hoc t-tests were completed with the older group set as the reference. These show that Auckland Under 25, compared to Auckland 40+ speakers, have lowered and retracted **TRAP** (AgeY:t (66)=7.4, p<.0001; typeF2:AgeY: t(4555)= -6.5, p<.0001), **DRESS** (AgeY:t (66)=4.88, p<.0001; typeF2:AgeY: t(5445)= -4.75, p<.0001), and **NURSE** (AgeY:t (66)=6.35,

p<.0001; typeF2:AgeY: t(1951)= -8.7, p<.0001) vowels. Interestingly, however, the **KIT** vowel is not significantly different between the two groups.

Table 3. Analysis 1: Auckland 40+ vs. Auckland Under 25 (*Null model vs g1 model (Age)).*

	Degrees of Freedom	AIC Difference	Log Likelihood Ratio	P-value
TRAP	10	-38.14	42.14	<.0001
NURSE	10	-48.76	52.76	<.0001
DRESS	10	-18.86	22.86	<.0001
KIT	10	-0.8	4.81	0.0905

Analysis number 2 (*Table 4)* compares the two older groups and finds one significant difference at 0.01. The post-hoc t-tests with Auckland as the reference shows that the Nelson speakers have a lowered and retracted **KIT** vowel compared to the Auckland speakers (PlaceN:t (38)=3.95,p0.0003; typeF2:PlaceN: t(3071)= -4.38,p<.0001). Previous NZE research has identified **KIT** lowering/retraction is a stigmatized feature of broad NZE which may explain this difference [23].

Table 4. Analysis 2: Auckland 40+ vs. Nelson 40+ (*Null model vs g1 model (Place)).*

	Degrees of Freedom	AIC Difference	Log Likelihood Ratio	P-value
TRAP	10	2.247	1.75	0.42
NURSE	10	1.5	2.5	0.29
DRESS	10	2.65	1.34	0.51
KIT	10	-14.19	18.19	0.0001

In the third analysis we look at differences between the two Nelson groups (*Table 5)*. We find two significant differences, for **NURSE** and **KIT**. The post-hoc t-tests with the Nelson 40+ speakers as the reference are as follows. Nelson under 25 speakers have lowered and retracted **NURSE** (AgeY:t (17)=3.56, p0.002; typeF2:AgeY: t(468)= -4.64, p<.0001) vowels, while **KIT** (AgeY:t (17)=-3.62, p0.002; typeF2:AgeY: t(1436)= 8.83, p<.0001) vowels are raised and fronted for the Under 25 group.

Table 5. Analysis 3: Nelson 40+ vs. Nelson Under+ (*Null model vs g1 model (Age) – significant differences (significance level 0.01)).*

	Degrees of Freedom	AIC Difference	Log Likelihood Ratio	P-value
TRAP	10	-3.127	7.13	0.02
NURSE	10	-11.48	15.47	0.0004
DRESS	10	0.112	3.89	0.14
KIT	10	-26.77	30.77	<.0001

Table 6. Analysis 4: Auckland Under 25 vs. (*Null model vs g1 model (Place) – significant differences (significance level 0.01)).*

	Degrees of Freedom	AIC Difference	Log Likelihood Ratio	P-value
TRAP	10	-0.54	4.53	0.1
NURSE	10	0.43	3.57	0.16
DRESS	10	-3.92	7.92	0.019
KIT	10	3.36	0.72	0.72

Our final analysis compares the mean formant values of the two younger groups (*Table 6)*. Surprisingly this analysis finds no significant differences between the Auckland and Nelson speakers Under 25.

4. DISCUSSION AND CONCLUSION

In this study we compared the monophthongs of NZE speakers from urban and regional New Zealand areas. Both the visual analysis and the statistical analysis support earlier research suggesting the **TRAP**, **DRESS**, and **NURSE** vowels are lowering and retracting for young Auckland speakers compared to older Auckland speakers. For these speakers, however, the short front vowel **KIT** does not appear to be raising or fronting in response to this shift. This may be because of its status as an identity marker for NZE speakers as one of the major features that differentiates NZE and Australian English [20]. In addition, we have shown that for both Auckland speakers Nelson speakers aged 40+ **DRESS**, **TRAP** and **NURSE** remain raised and fronted. This suggests front vowel lowering in NZE is a relatively recent phenomenon.

One purposes of this analysis was to investigate whether vowel lowering is a regional change for young Aucklanders. It appears this may not be the case. For Nelson speakers Under 25 the **NURSE** vowel, is lowered and retracted to a similar height and backness as the Auckland speakers. While their **TRAP** and **DRESS** vowels are not significantly different to either Auckland under-25 or Nelson 40+ speakers. These results lead us to conclude that while Auckland speakers under 25 appear to be most advanced in this sound change, these sound changes might not indicate a regional change. These results may instead indicate sound change emerging from the linguistically diverse Auckland which are then being adopted by young people elsewhere in New Zealand. This is an interesting finding considering NZE research from outside Auckland has maintained that vowel raising for **DRESS**, **TRAP** and **NURSE** is ongoing [6, 24]. Given the small size of the regional dataset in this study, however, further data from other New Zealand regions is needed.

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