Young Aucklanders and New Zealand English Vowel Shifts

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Abstract

Two distinctive features of New Zealand English are the short front vowel shift, and the articulation of the NURSE vowel. These shifts have resulted in raised pronunciations of DRESS, TRAP, NURSE. Until recently, New Zealand English research has suggested that these changes are ongoing with little regional variation. In the following paper we report findings from a study with Auckland based New Zealand English speakers which suggest this might be changing. Sociolinguistic interviews were recorded with 67 Auckland based participants. Speakers are stratified by age (16-25 and 40+) and gender. Hand-corrected formants from stressed vowels, marked at the vowel target, were analyzed. The analysis looks at over 20,000 monophthong tokens. The results suggest there are differences between the older and younger speakers. The younger speakers have lowered and retracted DRESS, TRAP and NURSE vowels. Although some results are confounded by the effects of aging on the vocal tract. The implication of these results is discussed.

Index Terms: New Zealand English, Auckland, Vowels, Acoustic Analysis, Sound Change, Monophthongs

1. Introduction

Two distinctive features of New Zealand English (NZE) are the short front vowel shift and the articulation of the NURSE vowel. The first results in raised DRESS and TRAP vowels, and a lowered and retracted KIT vowel [1]. In addition, the raising of DRESS has also resulted in the diphthongization of the long FLEECE vowel [2,3]. The second is characterized by raising of the NURSE vowel towards GOOSE [4]. Until recently, New Zealand English phonetic research has concluded that these shifts are ongoing in NZE, with continued DRESS raising and a greater onglide for FLEECE [1, 2, 3, 5, 6]. These claims have been made, however, assuming that New Zealand English lacks regional variation [7,8].

While this may be historically true, this may no longer be the case, with the most recent research on NZE in New Zealand's largest city Auckland [9, 10]. Auckland has undergone notable demographic change with over 40% of its residents born overseas [11]. For some of these migrants English is a new language, while for others a different variety of English is the spoken norm. As noted in Cheshire and other European research, such linguistic diversity can be a catalyst for linguistic change [12].

The phonetic analysis of young NZE speakers in Auckland [9, 10], contrary to previous NZE research, found TRAP and DRESS lowering and reduced FLEECE diphthongization. As the findings from this study were limited to read speech from young speakers, the conclusions reached in this analysis were preliminary in nature. The current study expands on that research by acoustically analyzing the speech of older Aucklanders together with younger speakers and by focusing on conversations rather than read speech from these speakers. In addition to analyzing changes in the short vowels the study will also consider the NURSE vowel. Widening the lens to look beyond the short front vowels, and to investigating the natural speech of both young and old speakers in Auckland, will provide us with more reliable apparent time evidence of sound change in Auckland.

2. Method

2.1. Speakers

This analysis uses data collected for the Auckland Voices Project (details in [9]). It consists of 67 NZE speakers from Auckland, stratified by age and gender (Older n=29 (17 women, 12 men), Younger n=39 (20 women, 18 Men)). Participants were recorded in a sociolinguistic style interview for 1-2 hours in a quiet location of their choice. Speech was recorded on a Zoom H5 using TDK lavalier clip-on microphone. The speech signal was sampled at 44.1 kHz and quantized to 24 bit. In instances where the main microphone failed, backup recordings from the Zoom H2 were used. See [9] for more details. Older participants were aged 40+ and younger participants were aged 16-25. Speakers were all either New Zealand born or arrived in New Zealand under the age of seven. Older speakers must have lived in Auckland for 20+ years.

Table 1. *Vowel Tokens by age and gender*

	Older Women	Older Men	Younger Women	Younger Men
TRAP	666	445	862	713
GOOSE	317	198	377	320
NURSE	280	184	294	252
STRUT	606	325	654	506
START	309	182	354	278
DRESS	677	365	933	775
KIT	723	469	922	688
FLEECE	706	413	650	637
LOT	547	399	611	576
THOUGHT	374	301	409	366
FOOT	150	89	225	200

2.2. Data Preparation

Ten minutes of speech was selected from the 30-minute mark of each interview. This was selected as a time point far enough into the interview for the speaker to be comfortable with the recorder, but before the speaker might be fatigued. The recordings were transcribed using ELAN [13] and passed through WebMAUS (NZ English service) [14]. Further

preparation was done using the EMU-webApp [15]. Phonetic boundaries were hand checked and corrected where necessary. Formant tracks were calculated using EMUR [14] in R [16], then these were hand checked and corrected in the EMU-WebApp where necessary. The vowel targets of stressed monophthongs were labelled based on the criteria given in [17]. The F1 and F2 values were extracted at each vowel target using EMUR in R which was used for the remainder of the analysis. The analysis includes over 20,000 monophthong tokens. Although the focus of this study is the DRESS, TRAP and NURSE vowels, we analyzed all 11 NZE monophthongs to capture the scope of the whole vowel system. *Table 1* provides the number of tokens for each vowel by age and gender.

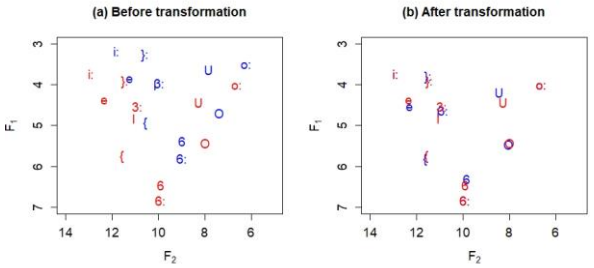

Figure 1. *Raw men's (Blue) and women's (Red) centroids (left), Transformed men's (blue) vowel space on to women's (red) vowel space. (right)*

The statistical analysis includes a data transformation to account for frequency differences between male and female voices. This is a simple linear transformation which transforms male formant values into values closer to female formant using the anchor vowels FLEECE, THOUGHT and START. This results in the transformation shown in *Figure 1*. A full explanation of this transformation is given in [10].

3. Results of Analysis

3.1. Vowel Spaces

Figure 2 shows the results of the formant analysis. The formant values are in bark, with F1 on the Y axis and F2 on the X axis. All four plots show the familiar New Zealand English triangular vowel space, characterized by the centered START and STRUT vowels. All four plots also show a fronted GOOSE vowel, and similar mid-back LOT vowels, as well as raised and retracted FOOT vowels. All groups also have the lowered and retracted KIT vowel distinctive to NZE. A visual inspection of the data, however, suggests that TRAP and DRESS are lowered and retracted for younger men and women in the Auckland Voices database. In addition, NURSE is lowered, patterning with KIT rather than GOOSE for both younger groups. Between the two younger groups there are few visual differences in terms of the overall vowel space, whereas for the older groups the DRESS and NURSE vowel are marginally closer among the older women.

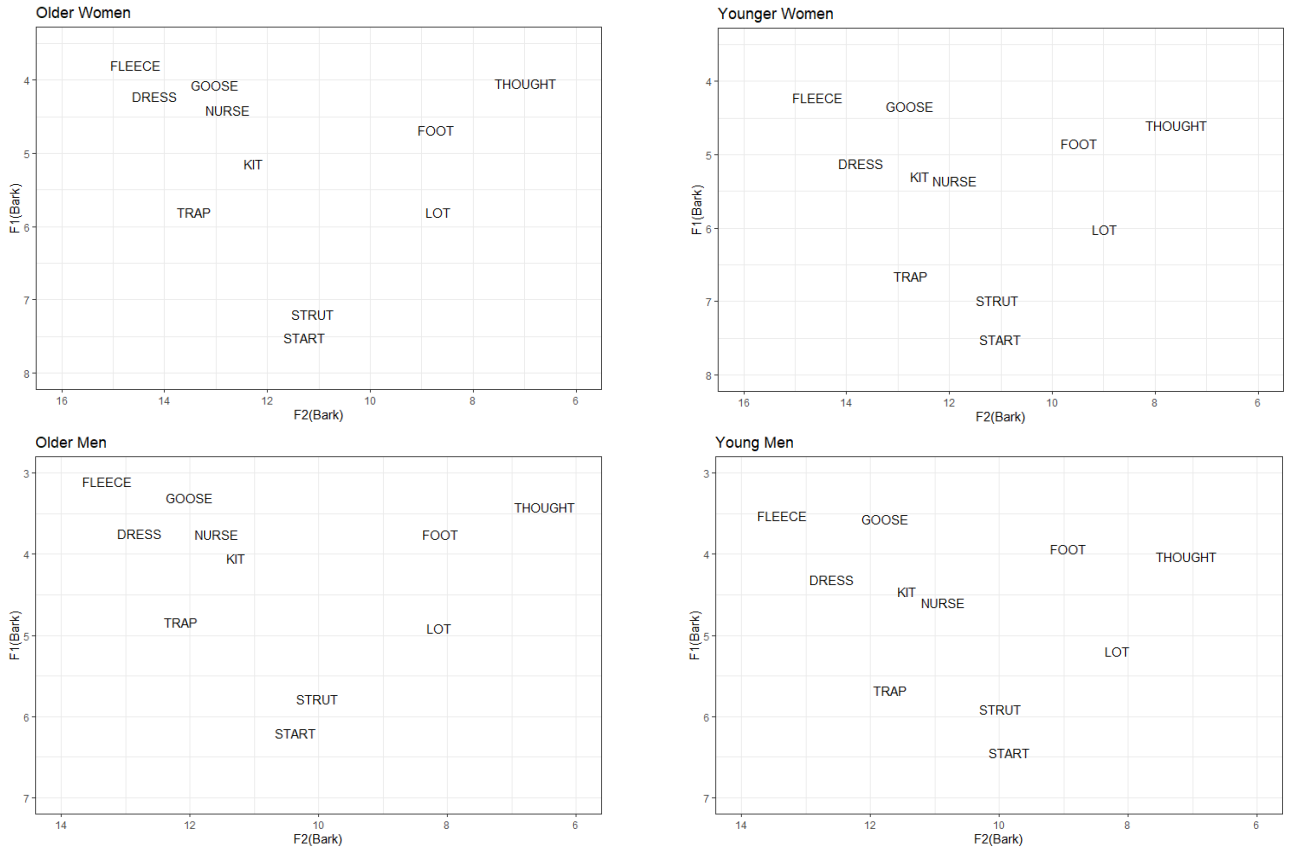

Figure 2: *F1/F2 plots of all speaker groups. Centroids are untransformed means.*

3.2. Statistical analysis

We performed a statistical analysis to investigate whether the differences observed in *Figure 2*. were significant. All statistical analyses were performed in R [16], following the same methodology as [10] and [18]. The linear mixed models were calculated using the `lme()` function in the `nlme` package. This statistical analysis also models F1 and F2 simultaneously in the 2-D formant space. This allows for changes in any direction of the formant plane to be detected. For each vowel four linear mixed models were built for observations of the first and second formants. All models had speaker as a random effect. Fixed effects for each model are given in Table 2. Comparison between models was done with the `nlme` package using the `anova()` function.

Table 2. *The four models used in the investigation.*

Model	*Fixed Effects*	*Random Effects*	*Observation*
Null	Type	Speaker	Formant value
g1	Type*Sex	Speaker	Formant value
g2	Type*Age	Speaker	Formant value

When the null model was compared with g1 (Type*Sex) there were no significant differences at a significance level of 0.01. This suggests that gender differences in this dataset are negligible. When the null model was compared with g2 (Type*Age) there were eight vowels which differed significantly at a significance level of 0.01. These are shown in Table 3. Further analysis from post-hoc t-tests were completed with the older group set as the reference. Full results cannot be reported here for space reasons. The t-test results for our three vowels of interest DRESS, TRAP and NURSE are as follows. Younger speakers DRESS vowel is significantly lower and retracted than for the older speakers (ageY:t (66)=8.14,p<0.01; typeF2:ageY: t(5421)= -7.46,p<0.01). The TRAP vowel is also lowered and retracted for the younger speakers (ageY: t(66)= 9.07,p<0.01; typeF2:ageY: t(5287)= −11.34,p<0.01). Finally, NURSE is also retracted and lowered for the younger speaker group (ageY: t(66)=10.19, p<0.01; typeF2:ageY: t(5287)= -10.68,p<0.01).

Table 3. *Null model vs g2 model – significant differences (significance level 0.01).*

	Degrees of Freedom	AIC Difference	Log Likelihood Ratio	P-value
TRAP	18	68.5	72.502	<.0001
NURSE	18	70.107	74.106	<.0001
START	18	10.686	14.686	6e-04
DRESS	18	43.937	47.937	<.0001
KIT	18	12.08	16.075	3e-04
FLEECE	18	15.141	19.141	1e-04
THOUGHT	18	28.548	32.548	<.0001
FOOT	18	15.282	19.282	1e-04

In addition to the statistical analysis *Table 4.* gives the mean formant values in Bark for the first and second formants for each significant vowel. The mean is calculated from women speakers and the transformed men's values shown in *Figure 1*. Similar observations can be made to those found in the visual and statistical analysis. Most notably, the difference between the F1 and F2 means for DRESS, TRAP, and NURSE when comparing the older and younger speakers.

Table 4. *Mean values of F1 and F2 given in Bark vowel target (T1 and T2) for TRAP, NURSE, START, DRESS, KIT, FLEECE and FOOT by age and gender.*

Vowel	Group	F1	F2
TRAP	Old W.	5.33	11.89
	Old M.	5.25	11.92
	Young Y.	5.99	10.61
	Young M.	6.12	10.7
NURSE	Old W.	4.09	11.38
	Old M.	4.1	11.15
	Young Y.	5.02	9.47
	Young M.	4.94	9.75
START	Old W.	6.86	10.05
	Old M.	6.67	10.44
	Young Y.	6.65	10.2
	Young M.	6.88	9.73
DRESS	Old W.	3.93	12.58
	Old M.	4.1	12.22
	Young Y.	4.89	11.03
	Young M.	4.69	11.52
KIT	Old W.	4.7	10.89
	Old M.	4.42	11.27
	Young Y.	4.62	11.47
	Young M.	4.82	11.19
FLEECE	Old W.	3.56	12.89
	Old M.	3.51	12.85
	Young Y.	3.91	12.42
	Young M.	3.86	12.64
THOUGHT	Old W.	3.8	6.37
	Old M.	3.71	6.42
	Young Y.	4.18	6.62
	Young M.	4.28	6.58
FOOT	Old W.	4.32	7.88
	Old M.	4.04	8.15
	Young Y.	4.23	8.66
	Young M.	4.3	8.66

3.3. Effects of Aging Voices

Although our vowels of interest are significantly different, it should be noted that other vowels show significant difference where we might not expect them to. For example, our anchor vowels FLEECE and THOUGHT. We believe that this is a result of our models not considering the impact of age on the vocal tract. While we performed a transformation to account for gender based vocal tract differences, we did not perform one to account for age based vocal tract differences. Harrington, Palethorpe and Watson [19] look at the impact of aging on formant values and find that as speakers get older their mean F1 and the F2 values, particularly of back vowels, lower. While the data presented in [5] demonstrates the impact aging has on the NZE vowel space specifically.

We can see these effects in place among our data if we look at *Figure 3.* comparing the centroids of our older and younger women. Visual inspection here suggests a similar pattern found in [5, 19]. For example, the centroid for FLEECE is much higher for the older women than the younger women and THOUGHT and FOOT are higher and more retracted. This is

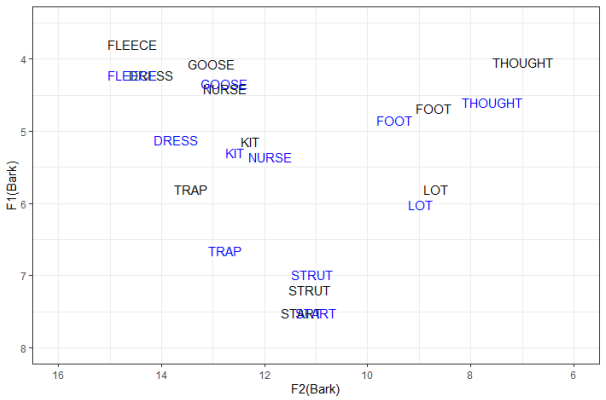

Figure 3. *Centroids of young women (blue) and older women (black).*

an important finding as it suggests the importance of looking at the overall shape of the vowel space rather than means in isolation. To account for this in future analyses, we have several options to consider, such as incorporating aging effects into our linear transformation, using a Vowel Space Measure (VSM) to calculate the distance between vowels in the vowel space such as in [5], or using an alternative method of vowel normalization.

4. Discussion and Conclusion

In this study we compared the speech of two groups of Auckland based NZE speakers. A visual inspection of Figure 1. clearly indicates that for young speakers the DRESS, TRAP and NURSE vowels are lowered and retracted. In particular, for DRESS and NURSE, the centroids of the older women are approaching those of FLEECE and GOOSE respectively, whereas for the younger speaker groups they are more similar in height to the KIT vowel. Additionally, we can conclude that the lowering and retraction may be motivated by the TRAP vowel, as the lack of significant age and gender interactions for KIT suggests it is not undergoing change at this stage. While our statistical analysis supports these findings, it also finds significant differences that might not be expected for example FLEECE, THOUGHT, and FOOT. We believe this is due to aged-based vocal tract differences – not due to phonetic shift. This limits the strength of the findings from the statistical analysis.

Nevertheless, there is an important preliminary finding from this study, which is sound change among NZE speakers in Auckland. If the sociolinguistic patterns of NZE as identified in [20] remain true, this finding is important because it involves the reversal of two well established patterns of change in NZE. Those being short front vowel raising and NURSE raising. In NZE, older women tend to use more conservative variants, and younger speakers, in particular younger women, use more innovative variants [20]. In the case of these Auckland speakers, the younger speakers have lowered and retracted vowels indicating the direction of change is towards these lowered and retracted variants. This contradicts NZE research from outside Auckland which has maintained that vowel raising for DRESS, TRAP and NURSE is ongoing [5, 6]. With DRESS raising to be as high and front as FLEECE, and NURSE raised towards GOOSE. It does, however, support findings from our previous research looking exclusively at the younger speakers in Auckland [9, 10]. It also supports earlier research looking at Auckland based Pasifika speakers of NZE [21].

These findings can be interpreted in two different ways. First, they may suggest there is a difference between the English spoken in Auckland and the English spoken elsewhere in New Zealand. Or alternatively, we could be seeing changes to NZE emerging and spreading from the most linguistically diverse and innovative part of the country. An analysis of a group of NZE speakers from outside of Auckland is underway to provide more insight into these findings. It is also of some interest that the lowering of DRESS and TRAP also mirrors similar research on Australian English [22, 23], which has found lowering for these two vowels amongst Sydney based speakers, a comparably large and diverse city.

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