A Study of the /el/-/æl/ Merger in New Zealand English

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Abstract

Ten speakers of New Zealand English (NZE) took part in an experiment to explore the possible merger of /el/ and /æl/ in NZE. The experiment was conducted in two parts: perception and production. The results show that there is indeed a merger and that the degree to which that merger exists differs from speaker to speaker.

Introduction

The /el/-/æl/ merger in New Zealand English is not well studied. It is referred to in various sociolinguistic publications on NZE, but usually only as a small section of the larger change undergone by vowels preceding /l/, or mentioned in passing in articles on /l/ vocalization. There do not appear to be many major articles solely devoted to exploring the nature of a possible /el/-/æl/ merger. Horsfield (2001) investigates the effects of postvocalic /l/ on the preceding vowel in NZE, but her investigation covers all of the NZE vowels and is not specifically tailored to studying mergers or neutralisations, but rather the broader change that occurs across the vowels. She suggests that 'further research involving minimal pairs such as *tally/telly* and *salary/celery* would be needed for any firm conclusions to be drawn'. Such research can be found in Buchanan (2001) which is a pilot study much like this one, but by no means conclusive. Buchanan's investigation is split into two major sections: production and perception. It is well accepted that mergers must exhibit a loss of distinction on the production level, but the suggestion that a merger requires a loss of distinction in perception as well as in production (Gordon 2002) requires the inclusion of perception tasks in such experiments.

Buchanan's study uses two female speakers: one young (19 years) and one older (54 years). These speakers were selected to provide an age comparison only. Contrary to her predictions, Buchanan found that both speakers neutralised /e/ and /æ/ when they preceded /l/, and both performed poorly in the perception tasks. However, although it is not addressed in the report, interestingly the older speaker, who made more of a distinction between the two vowels in the production tasks, was the least accurate in identifying the words in the perception tasks. So in that particular respect, production did not match perception. However, as Buchanan pointed out herself, her results were merely suggestive since her study only included two people.

Aims

The primary aim of this research was to explore the possible merger of /el/ and /æl/ in NZE. A secondary aim was to analyse what differences may exist between the merger for male speakers and the merger for female speakers. This research was conducted on a small scale and, as such, should be considered as more of a pilot study than a complete investigation into the

nature of this possible merger. The study was divided into two main sections: perception and production. The aim of the perception experiment was to determine whether these NZE speakers *perceived* the distinction between /el/ and /æl/. The aim of the production experiment was to determine whether those same NZE speakers *produced* a distinction between /el/ and /æl/, and if not, to discover which phoneme they were merging on. Also, by comparing the perception results with the production results for individual speakers, this study set out to determine whether there is any direct correlation between the rate of perception and the rate of production. Because of time constraints the conditioning factors of age and class were excluded from consideration in this study. All the participants were aged between 18 and 25 years.

Method

Speakers

Eight people took part in this study: four males and four females. All of the speakers were students at the University of Canterbury, Christchurch and aged between 18 and 25 years. Although they were all studying in Christchurch, they came from all over the country. All of the speakers were standard NZE speakers (no Maori participants, although the speech of the female speaker from Northland exhibited a clear Maori English influence). The speaker on the perception tasks tape (played to the participants) was a speaker of NZE who did not merge /el/ and /æl/, aged between 18 and 25, and was also a student at the University of Canterbury.

Production Tasks

The production part of the experiment was divided into three tasks.

Task One was a control task, intended to yield baseline productions for /e/ and /æ/. In it, participants were required to read aloud a word list not including words containing the conditioning factor, but including words containing the vowels /e/ or /æ/. The F1 and F2 values for these target vowels were recorded and used as markers in the final analysis. Speakers were asked to read each word only once. The word list contained six words in total.

Task Two required the participants to read aloud a word list of 104 words divided into groups of four. Concealed in the list were twenty target words (ten minimal pairs: *melody/malady, pellet/palate, celery/salary, shell/shall, telly/tally, sell/Sal, Ellie/alley, mellow/mallow, Kelvin/Calvin, Ellen/Alan*). Each group of four words contained a maximum of one target word, which, to avoid the effects of 'list-reading intonation' were not entered as the first or last word of the group. All of the words appeared in a completely random order. The aim of this task was to have the target words produced in isolation from each other.

Task Three required the participants to read aloud another word list, but this time the list contained only the target minimal pairs and some similar sounding words, or words which were orthographically similar. There was a total of twenty pairs of words, included in which were the ten target minimal pairs. Again, all the pairs occurred in a random order. The purpose of this task was to see if speakers made a distinction when reading minimal pairs. All three production tasks are included in the appendix to this report.

Speakers were recorded and the results analysed using Praat, a computer programme for speech analysis and synthesis (Boersma and Weenink). The application and its documentation are both available online at: ‹http://www.praat.org›. Because of time constraints only the speakers who exhibited the highest accuracy and the lowest accuracy in the perception tasks for each gender (i.e. two males and two females) were analysed for the production part of the experiment.

Perception Tasks

The perception part of the experiment consisted of two tasks. In Task One the participants listened to a recording of a speaker with an /el/-/æl/ distinction, in which they heard a list of single words sounded once each. Participants were required to choose which word they thought they heard from two choices for each word printed on an answer sheet. The words sounded were either words from the list of ten minimal pairs or completely unrelated words used as fillers so that participants were not aware of which linguistic variable was being investigated. Also included in the list were words containing the vowels /e/ or /æ/ without the conditioning factor (/l/) to be used as controls ensuring that participants could correctly identify these words. All the words in the list were played in a completely random order. There were 26 words in total sounded in Perception Task One.

In Task Two participants listened to a recording of the same speaker as in Task One read pairs of words. Each pair was one of four pairings possible from the minimal pairs: for example, the four possible pairings for the minimal pair *telly, tally* are *telly-telly, tally-tally, telly-tally, tally-telly.* All four possible pairings for each minimal pair were included in the recording for Task Two, all in random order and interspersed with other pairs. Participants were required to select on the answer sheet which one of the four possible pairings they thought they were hearing in the order in which they occurred. For both Tasks One and Two participants were instructed to answer every question and not to refer back to previous answers. They were informed that the same word or pair may be played more than once, and they were instructed to put a question mark next to any answers that were based on a complete guess. There was a total of 40 questions in Task Two.

The recording played in both perception tasks used the same token of each word in both tasks, except for those questions in Task Two which required a pair of identical words. In these cases separate tokens of the same word were played so that participants' responses would be based solely on vowel perception, not recognition of a single repeated token. Care was taken to select for each word two tokens with very similar F1 and F2 frequencies, vowel length and quality. For all word pairs the individual tokens in each pair were matched as far as possible for duration and intonation.

The perception tasks are shown in Appendix 1.

The production tasks were performed before the perception tasks. This was because the perception tasks could have made it fairly clear what the variable under investigation was since there were fewer filler words included in the lists. The production tasks were designed in such a way that it would not be obvious which variable was under investigation. Even more importantly, though, the production tasks preceded the perception tasks because in the perception tasks participants listened to a recording of a

speaker who did distinguish /el/ and /æl/. If this had been played to them before the production tasks it might well have affected the results.

The production tasks are shown in Appendix 2.

Results

The most practical method of showing the results of this study is to focus on each section individually and then to look for correlations between the two. However, since the selection of speakers for production analysis depended on the results obtained in the perception analysis, I begin this section of the report with the perception results, even though the production part of the experiment came first.

Perception.

Task One:

Table 1 shows the rate of accuracy for all eight speakers in Perception Task One.

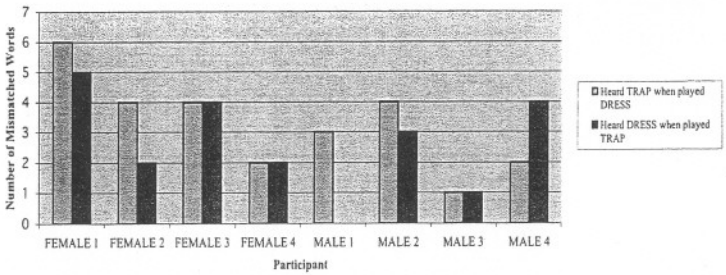
Table 1: Accuracy Rates for Perception Task One.

FEMALE 1	FEMALE 2	FEMALE 3	FEMALE 4
57.7%	76.9%	73.1%	84.6%
MALE 1	MALE 2	MALE 3	MALE 4
88.5%	73.1%	92.3%	75.1%

In the above table, and all following tables and charts, the participants are labelled MALE or FEMALE respectively and assigned a number from one to four. The number assigned to the participant reflects their ranking over both perception tasks: participant 1 being the one who performed with the lowest accuracy over all, and participant 4 with the highest. As can be seen in Table 1, FEMALE 1 performed the task with the lowest rate of accuracy, with a score not much higher than what would be expected from someone who selected their answers purely by chance. MALE 3, on the other hand, performed the task with great accuracy. On average the male participants appear to have performed this task more accurately than the female participants, but looking at the individual figures shown in Table 1 there does not appear to be any reliably outstanding difference between the accuracy of male participants and female participants for Perception Task One.

Knowing participants' rates of accuracy is helpful information, but what about their inaccuracies? What mistakes did participants make? Chart 1 shows what participants thought they heard when they mismatched. Participants were instructed to mark on their answer-sheets any answers that were based on complete guesswork with a question mark. It is interesting to note here that MALE 4 marked every answer in Perception Task One with a question mark (and almost all in Perception Task Two).

Chart 1: Mismatch Data for Perception Task One.



As can be seen in Chart 1, two out of the four female participants show equal occurrences of mismatching /el/ with /æl/, and /æl/ with /el/. The other two show a tendency to hear /æl/ more than /el/. Two out of the four male participants show a tendency to hear /æl/ more than /el/ (particularly MALE 1, who at no point in perception task one heard /el/ when played /æl/), and one male participant shows equal occurrences of mismatching, while the other is the only participant to show a tendency for hearing /el/ over /æl/. These results suggest that people are less likely to perceive /el/ accurately, although clearly more data would be necessary to establish whether this tendency is reliable.

Task Two:

Table 2 shows the rate of accuracy for all eight speakers in Perception Task Two.

Table 2: Accuracy Rates for Perception Task Two.

FEMALE 1	FEMALE 2	FEMALE 3	FEMALE 4
45%	47.5%	70%	80%
MALE 1	MALE 2	MALE 3	MALE 4
32.5%	60%	50%	69.5%

Table 2 shows that the female participants performed this task more accurately (with the exception of FEMALE 2), and overall that is true. There is quite a range of percentages shown in this table, 32% from MALE 1 to 80% from FEMALE 4. Table 3 compares the accuracy rates for Perception Tasks One and Two.

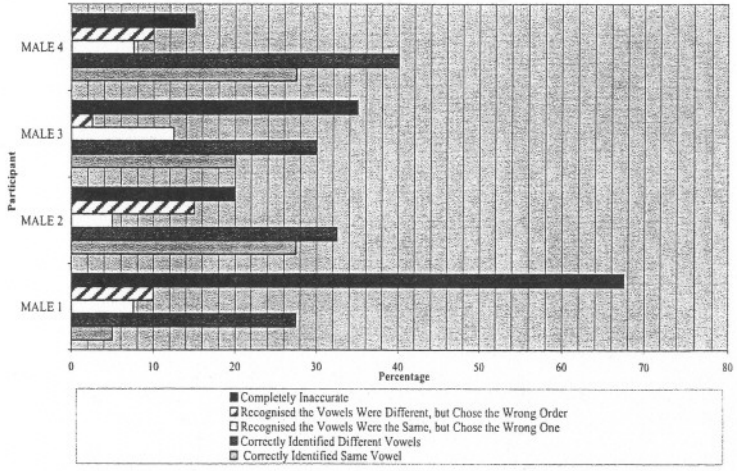
Table 3: Accuracy Rates for Perception Tasks One and Two

	FEMALE 1	FEMALE 2	FEMALE 3	FEMALE 4
Task One	57.7%	76.9%	73.1%	84.6%
TaskTwo	45%	47.5%	70%	80%
	MALE 1	MALE 2	MALE 3	MALE 4
Task One	88.5%	73.1%	92.3%	73.1%
TaskTwo	32.5%	60%	50%	67.5%

Looking at Table 3 it is clear that all participants scored more highly in Perception Task One, particularly MALE 1 who performed with much greater accuracy in Perception Task One than in Perception Task Two. It is also clear that the accuracy ranking for Perception Task One, is not the same as for Perception Task Two.

Again, it is helpful to know participants' *accuracies*, but it would also be interesting to analyse their *inaccuracies*. Charts 2 and 3 show in more detail where participants' accuracies and inaccuracies lie for Perception Task 2.

Chart 2: Analysis of Male Participants' Answers for Perception Task Two



In Chart 2 it is evident that all male participants performed better at correctly identifying the words if the vowel preceding /l/ (/e/ or /æ/) was different in each word rather than if the vowels were the same. Two of the participants – MALE 1 and MALE 3 – had more completely inaccurate answers than ones where they recognised that the vowels before /l/ were the same or different, but chose the wrong option. Interestingly, MALE 4 performed most

accurately but placed question marks next to almost all of his answers, indicating that he felt he was basing those answers on complete guesswork.

Chart 3: Analysis of Female Participants' Answers for Perception Task Two

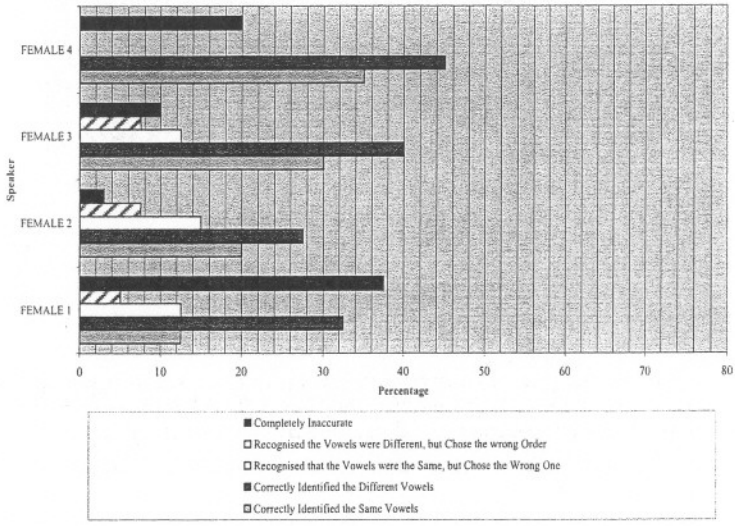


Chart 3 also shows a tendency for all the participants to perform better at correctly identifying the words if the vowel preceding /l/ (/e/or /æ/) is different in each word rather than if the vowels are the same. This is possibly because of the contrast created by the different vowels which may aid perception. FEMALE 4 exhibits great accuracy, even though her inaccuracies are all completely inaccurate, as it were.

The perception results alone show that there was a range of perception ability exhibited by the eight participants, and that the female participants were slightly more accurate than the male participants. However, it is in conjunction with the production data that the perception results will be of most value.

Production

Task One:

Production Task One was conducted as a control task. The participants were asked to read a list of words, none of which contained /el/ or /æl/, but of which two contained /e/ and /æ/ respectively, in a relatively neutral environment. Those two words were *head* and *had*. However, further into the study, it became apparent that since the F1 and F2 frequencies for /el/ and /æl/ in the target words were to be recorded and averaged from up to ten occurrences each, it would be incomparable to take the F1 and F2 frequencies for the baseline productions of /e/ and /æ/ from only a single occurrence. It was for this reason that the F1 and F2 frequencies for /e/ and /æ/ were recorded from all words in the production lists that contained them not preceding /l/. Those words were: *had, Maggie, panic, madam, sand, pamphlet,*

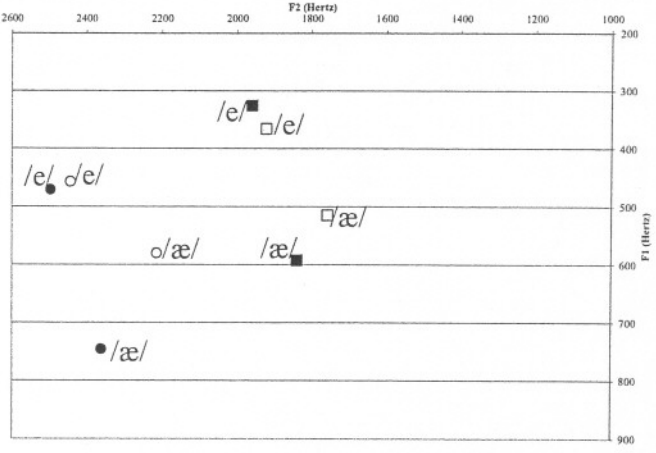
wagon, hat, and *head* (two counts), *penicillin, adrenaline, chemistry, schedule, treasury*). Thus, Production Task One was not as useful as intended. The resultant baseline production frequencies for /e/ and /æ/ are shown in Table 4. It is important to note that five out of the seven baseline TRAP words contained /æ/ in a nasal environment. These tokens could have slightly brought down the F1 average for baseline /æ/, causing it to appear higher than perhaps expected, and so great care was taken to extract formant frequencies from the mid-point of the vowels to minimise the effect of neighbouring nasal consonants.

Table 4: Average Baseline Production Frequencies for Male and Female Participants

	F1 (Hertz)	F2 (Hertz)
/æ/ FEMALE 1	746	2360
/e/ FEMALE 1	471	2496
/æ/ FEMALE 4	580	2214
/e/ FEMALE 4	457	2443
/æ/ MALE 1	593	1838
/e/ MALE 1	326	1959
/æ/ MALE 4	515	1757
/e/ MALE 4	366	1920

Only the participants who performed most and least accurately in the perception tasks (FEMALE 1, FEMALE 4, MALE 1 and MALE 4) were analysed for their production data. As would be expected, all participants exhibit a lower F1 and a higher F2 for /e/ than for /æ/. The data in Table 4 is expressed in Chart 4 below:

Chart 4: Average Baseline Production Frequencies for Male and Female Participants



Task Two

The aim of Production Task Two was to see if any distinction was made between /el/ and /æl/ in a mixed word list. Table 5 shows the averaged results for each of the participants. Raw data are provided in appendix 3.

Table 5. Results from Production Task Two

	Mean /el/ F1 (Hz)	SD	Mean /æl/ F1 (Hz)	SD	Mean /el/ F2 (Hz)	SD	Mean /æl/ F2 (Hz)	SD
MALE 1	551.4	69.92	517.9	79.20	1633.8	72.88	1620.4	97.91
MALE 4	477.6	46.91	474.4	15.31	1593.4	70.85	1590.8	70.45
FEMALE 1	623.4	60.48	675.2	76.28	2171.4	117.18	2110.9	73.20
FEMALE 4	607.9	142.37	611.6	95.04	1869.3	95.29	1934.1	115.29

A comparison between Tables 4 and 5 shows that there is a significant difference between the results gained in Production Tasks One and Two for MALE 1. The baseline frequencies in Task One show a typical trend in which /æ/ has a lower F2 and a higher F1. In Table 5, however, it is evident that MALE 1 does not maintain such a distinction in Task Two. In fact, the data in Table 5 show that MALE 1's /el/ is nearer his baseline /æ/ than /e/.

What we would hope to find with MALE 4 is that, since he was the most accurate male participant in *perceiving* a distinction in the Perception Tasks, hopefully he would also be the best at *producing* the distinction. However, MALE 4 does not make a distinction for all the minimal pairs.

FEMALE 1 appears to maintain a slight distinction, though not to the degree expressed in Production Task One, and not uniformly. As with MALE 1, FEMALE 1's /el/ formants are closer to her /æ/ than her /e/.

FEMALE 4 produced random distinctions. Only two of the pairs (*celery/salary* and *Kelvin/Calvin*) were accurate, the others were mixed up. Compared with FEMALE 1, the expectation would be for FEMALE 4 to produce more distinctions, but this is not the case.

FEMALE 1 made accurate distinctions for five of the minimal pairs. Regardless, the distinctions produced by all participants in Production Task One are slight, and to base production data on such slight and random results would not be conclusive. It is for this reason that Production Task Three was carried out.

Task Three

Production Task Three consisted of a list of minimal pairs. The averaged results for each participant are shown in Table 6. Raw data are provided in appendix 3.

Table 6: Results from Production Task Three

	Mean /el/ F1 (Hz)	SD	Mean /æl/ F1 (Hz)	SD	Mean /el/ F2 (Hz)	SD	Mean /æl/ F2 (Hz)	SD
MALE 1	546.2	66.71	576	107.26	1553.6	59.71	1605.7	102.15
MALE 4	480.3	50.18	490.4	41.10	1633.9	128.06	1566	79.88

FEMALE 1	648.8	46.68	641.4	57.48	2133.7	102.64	2163.2	95.98
FEMALE 4	653.9	99.63	824.9	156.43	1898.6	147.83	1999.7	111.12

Table 6 shows that FEMALE 1 performed less accurately in Task Three (minimal pair list) than in Task Two, whereas MALE 4 performed more accurately in Task three.

Although a comparison between tables 5 and 6 would suggest that MALE 4 produced more accurate distinctions in the minimal pair list (task three) than in the mixed word list (task two), analysis of the F1 and F2 values gained from individual word pairs (see appendix) shows that this trend is not uniform. For example, MALE 4 produces a distinction between *telly* and *tally* in task two, but that distinction is lost in task three. In fact, all speakers produced distinctions in certain minimal pairs in task two which were not evident in those same pairs in task three.

Below are charts for each of the four participants, including data from all three tasks in the production section of this experiment.

Chart 5: Averaged Overall Production Results for MALE 1

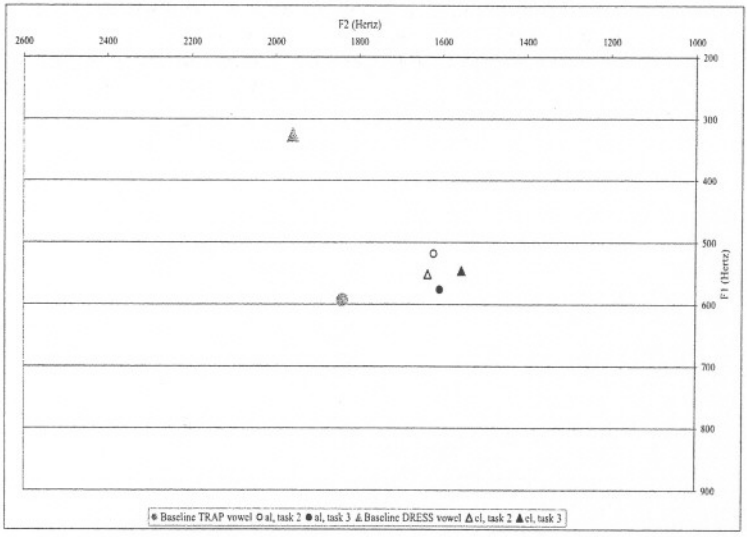


Chart 5 shows that over all, MALE 1 produced both /el/ and /æl/ in an acoustic space closer to baseline /æ/ than baseline /e/. Interestingly, the point on the chart closest to the baseline /e/ is the average value for /æl/ task two. It is clear from these results that MALE 1 appears to merge /el/ and /æl/.

Chart 6: Overall Production Results for FEMALE 1

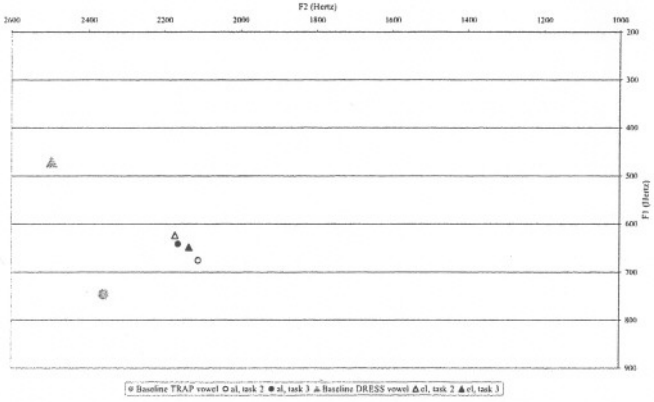


Chart 6 shows that FEMALE 1 did not make clear distinctions in any of the production tasks. Both her /el/ and /æl/ occupy the same acoustic space, somewhere in between baseline /e/ and /æ/, tending more toward /æ/.

So far, the overall production results are suggestive of some kind of merger. MALE 1 and FEMALE 1 performed least accurately in their perception tasks, and show a general lack of distinction in production. If MALE 4 and FEMALE 4 show more of a distinction in their respective productions, then that would suggest a clear relationship between production and perception.

Chart 7: Overall Production Results for MALE 4

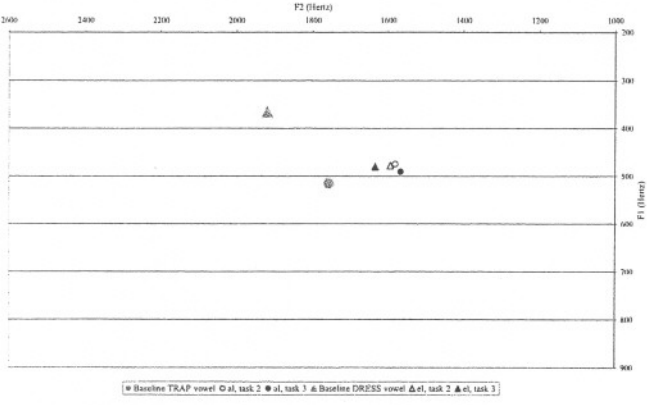


Chart 7 shows that both MALE 4's /el/ and /æl/ pronunciations are much closer to his baseline /æ/ than /e/. In fact, on average, they all fall slightly lower and more centralised than his baseline /æ/. This result does not show the clear distinction evident in his perception tasks, and thus there is not the

proposed clear correlation between perception and production as proposed by Gordon (2002).

Chart 8: Overall Production Results for FEMALE 4

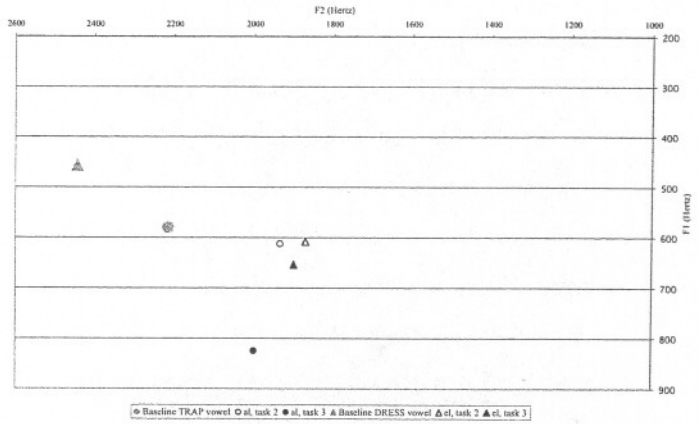
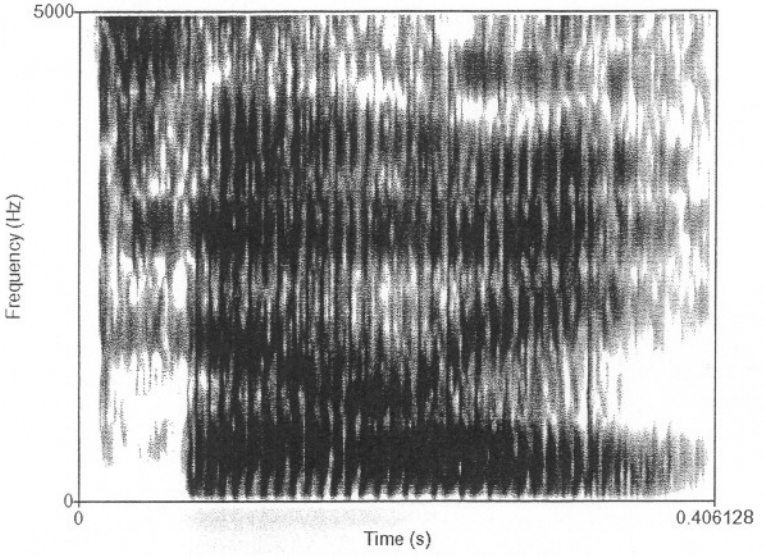


Chart 8 shows a large difference between /el/ and /æl/ pronunciations in Task Three. The /æl/ points for Task Three are, on average, much lower than the other points, and the corresponding /el/ points for Task Three are higher and more centralised. Results for task two, though, show no such distinction. The fact here is that FEMALE 4 is making a distinction between the minimal pairs but not when they are randomised in a mixed list of words. However, that distinction is not generated by producing a higher /e/ but rather by producing an extremely low /æ/.

The results of this study did not suggest any strong link between the rates of accuracy for production and perception. However, the one participant who produced a clear distinction in any of the production tasks (FEMALE 4) was the most accurate of all participants in the perception tasks.

It is a curious effect, that all the participants produced centralised /æl/ and /el/ values. The most plausible explanation for this peculiar behaviour is simple. The /l/ which follows the vowels has a distinct effect on their formant values. This can be seen in the spectrogram below:



It is evident from the spectrogram above, that the /l/ has the effect of lowering the F2 and slightly raising the F1 of the preceding vowel. This would account for the centralising evident in the /el/ and /æl/ productions.

Conclusion

The aims of this experiment were two-fold: first, to find out exactly what is happening with the possible merger of /el/ and /æl/, and second, to see what differences may or may not exist between male and female speakers regarding this merger. Unfortunately, there was no apparent difference between the male and female participants. That may well have been a result of the small scale nature of this experiment, and not reflective of society in general. However, the experiment did prove useful in answering questions related to the first aim. This study suggests that there is indeed a merger, but that varying degrees of merger are evident in society. Rates of accuracy in the perception tasks varied from relatively accurate perception to only slightly above chance perception. All participants in this study showed difficulty in producing clear and accurate distinctions between /el/ and /æl/, though everyone had a clear and accurate distinction between /e/ and /æ/. Merged or not, both /æ/ and /e/ for all speakers were somewhat centralised when preceding /l/. This is likely due to the behaviour of the /l/ in lowering the F2 significantly. As already stated earlier, the results from this pilot study can only be taken as suggestive because of the small number of participants involved. However, it does make some interesting suggestions that are now being followed up in a more comprehensive study.

Appendix 1

Perception Task One

This is an experiment about how words sound. Listen to the following recording and select, from the two options given, the word you think you hear. Do not worry if you are unsure, we are only interested in your first intuition. It is important that you circle an answer for every question, even if you are unsure. Some words may occur more than once throughout the recording. If your answer is based on a complete guess, please circle one of the two words, and then put a question mark next to the number.

(Correct answers underlined)

1)	a. shoe	b. show
2)	a. had	b. head
3)	a. had	b. head
4)	a. floor	b. flow
5)	a. food	b. feed
6)	a. cape	b. keep
7)	a. malady	b. melody
8)	a. palate	b. pellet
9)	a. celery	b. salary
10)	a. shell	b. shall
11)	a. tally	b. telly
12)	a. Sal	b. sell
13)	a. alley	b. Ellie
14)	a. mallow	b. mellow
15)	a. Calvin	b. Kelvin
16)	a. salary	b. celery
17)	a. melody	b. malady
18)	a. sell	b. Sal
19)	a. Ellen	b. Alan
20)	a. telly	b. tally
21)	a. mellow	b. mallow
22)	a. shell	b. shall
23)	a. palate	b. pellet
24)	a. Ellie	b. Alley
25)	a. Calvin	b. Kelvin
26)	a. Alan	b. Ellen

Please rate this task in terms of difficulty:

(Very difficult)	1.
(Difficult)	2.
(Moderately difficult)	3.
(Moderately easy)	4.
(Easy)	5.
(Very easy)	6.

Perception Task Two

This is an experiment about similar sounding words. Listen to the following recording and select which pair of words you think you hear in the order you hear them. Do not worry if you are unsure, we are only interested in your first intuition. It is important that you circle an answer for every question, even if you are unsure. The task is split into two sections, A and B, each consisting of 20 questions.

(Correct answers underlined)

SECTION A

1.	(a) palate pellet	(b) pellet palate
	(c) pellet pellet	(d) palate palate
2.	(a) melody melody	(b) melody malady
	(c) malady melody	(d) malady malady
3.	(a) celery salary	(b) salary salary
	(c) celery celery	(d) salary celery
4.	(a) shall shell	(b) shell shall
	(c) shell shell	(d) shall shall
5.	(a) tally tally	(b) telly tally
	(c) telly telly	(d) tally telly
6.	(a) alley Ellie	(b) Ellie alley
	(c) Ellie Ellie	(d) alley alley
7.	(a) sell Sal	(b) Sal sell
	(c) sell sell	(d) Sal Sal
8.	(a) mallow mellow	(b) mellow mallow
	(c) mellow mellow	(d) mallow mallow
9.	(a) Alan Ellen	(b) Ellen Alan
	(c) Ellen Ellen	(d) Alan Alan
10.	(a) Calvin Kelvin	(b) Kelvin Calvin
	(c) Calvin Calvin	(d) Kelvin Kelvin
11.	(a) pellet palate	(b) palate palate
	(c) pellet pellet	(d) palate pellet
12.	(a) malady malady	(b) melody malady
	(c) melody melody	(d) malady melody
13.	(a) celery celery	(b) celery salary
	(c) salary celery	(d) salary salary
14.	(a) shell shall	(b) shall shell
	(c) shell shell	(d) shall shall
15.	(a) tally telly	(b) telly telly
	(c) telly tally	(d) tally tally
16.	(a) alley Ellie	(b) Ellie alley
	(c) Ellie Ellie	(d) alley alley
17.	(a) Sal sell	(b) Sal Sal
	(c) sell sell	(d) sell Sal
18.	(a) mallow mallow	(b) mellow mallow
	(c) mellow mellow	(d) mallow mellow
19.	(a) Alan Ellen	(b) Ellen Alan
	(c) Ellen Ellen	(d) Alan Alan
20.	(a) Calvin Calvin	(b) Kelvin Calvin
	(c) Kelvin Kelvin	(d) Calvin Kelvin

SECTION B (same as section A) Remember, there are no right or wrong answers, so don't try to think about it too much.

1.	(a) palate	pellet	(b) palate	palate
	(c) pellet	pellet	(d) pellet	palate
2.	(a) malady	melody	(b) melody	malady
	(c) melody	melody	(d) malady	malady
3.	(a) salary	celery	(b) celery	salary
	(c) celery	celery	(d) salary	salary
4.	(a) shall	shell	(b) shell	shall
	(c) shall	shall	(d) shell	shell
5.	(a) telly	telly	(b) tally	tally
	(c) tally	telly	(d) telly	tally
6.	(a) Ellie	Ellie	(b) Ellie	alley
	(c) alley	Ellie	(d) alley	alley
7.	(a) Sal	sell	(b) sell	Sal
	(c) sell	sell	(d) Sal	Sal
8.	(a) mallow	mellow	(b) mellow	mallow
	(c) mellow	mellow	(d) mallow	mallow
9.	(a) Alan	Ellen	(b) Ellen	Ellen
	(c) Ellen	Alan	(d) Alan	Alan
10.	(a) Calvin	Kelvin	(b) Kelvin	Kelvin
	(c) Kelvin	Calvin	(d) Calvin	Calvin
11.	(a) pellet	palate	(b) palate	pellet
	(c) pellet	pellet	(d) palate	palate
12.	(a) malady	melody	(b) melody	malady
	(c) melody	melody	(d) malady	malady
13.	(a) salary	celery	(b) celery	salary
	(c) celery	celery	(d) salary	salary
14.	(a) shell	shell	(b) shall	shell
	(c) shell	shall	(d) shall	shall
15.	(a) tally	telly	(b) telly	tally
	(c) telly	telly	(d) tally	tally
16.	(a) alley	Ellie	(b) Ellie	alley
	(c) Ellie	Ellie	(d) alley	alley
17.	(a) Sal	sell	(b) sell	Sal
	(c) sell	sell	(d) Sal	Sal
18.	(a) mallow	mallow	(b) mellow	mellow
	(c) mellow	mallow	(d) mallow	mellow
19.	(a) Alan	Ellen	(b) Ellen	Alan
	(c) Ellen	Ellen	(d) Alan	Alan
20.	(a) Calvin	Kelvin	(b) Kelvin	Calvin
	(c) Kelvin	Kelvin	(d) Calvin	Calvin

Please rate this task in terms of difficulty:

(Very difficult) 1.

(Difficult) 2.

(Moderately difficult) 3.

(Moderately easy) 4.

(Easy) 5.

(Very easy) 6

Appendix 2

Production Task One

Read the following words out loud, pausing after each one:

1) **keep**
2) **had**
3) **head**
4) **floor**
5) **food**
6) **shoe**

Production Task Two

Read the following words out loud. Read across as naturally as possible:

1)	Elisabeth	Margaret	Ellie	Maggie
2)	buy	sell	purchase	market
3)	Malay	Monday	malady	moody
4)	trophy	telly	sugary	money
5)	bobbin	Calvin	penicillin	adrenaline
6)	keep	sleep	deep	wonder
7)	shade	shell	shoe	shoulder
8)	hear	hair	hare	here
9)	pottery	palate	price	panic
10)	mint	mop	mallow	Monday
11)	lane	alley	street	road
12)	mouse	madam	melody	mother
13)	sand	soap	salary	sister
14)	ticket	tally	Tony	teacher
15)	cage	chemistry	Kelvin	khaki
16)	chauffeur	shall	schedule	shoot
17)	artillery	artery	celery	treasury
18)	hid	head	heed	hide
19)	droplet	pamphlet	pellet	ringlet
20)	Ellen	Ellen's	Ellens'	Ellens
21)	shoe	shoes	shoe's	shoes'

22)	floor	shoe	mellow	slow
23)	wagon	woman	wigwam	Winston
24)	food	hood	soon	cook
25)	Sally	Sali	Sal	Suzie

Production Task Three

Read the following words out loud with a brief pause after each pair:

1)	sew	so
2)	which	witch
3)	palate	pellet
4)	foot	food
5)	melody	malady
6)	bear	beer
7)	celery	salary
8)	shall	shell
9)	time	thyme
10)	telly	tally
11)	motel	model
12)	alley	Ellie
13)	Sal	sell
14)	lock	loch
15)	mellow	mallow
16)	must	mustard
17)	Alan	Ellen
18)	breath	breathe
19)	here	hear
20)	Kelvin	Calvin

Appendix 3

F1 And F2 frequencies for Male 1 and Male 4, Female 1 and Female 4 in two production tasks

		F1	F2		F1	F2
Pellet	M1 Task 2	590	1675	Palate	672	1485
	M1 Task 3	misread	misread		misread	misread
	M4 Task 2	444	1588		488	1593
	M4 Task 3	521	1582		490	1612
	F1 Task 2	656	2093		696	2065
	F1 Task 3	625	2027		685	2034
	F4 Task 2	663	1694		misread	misread
	F4 Task 3	misread	misread		misread	misread
Melody	M1 Task 2	590	1698	Malady	misread	misread
	M1 Task 3	689	1784		misread	misread
	M4 Task 2	500	1521		misread	misread
	M4 Task 3	524	1543		misread	misread
	F1 Task 2	656	2093		785	2157
	F1 Task 3	631	2143		misread	misread
	F4 Task 2	530	1917		misread	misread
	F4 Task 3	689	1784		misread	misread
Celery	M1 Task 2	472	1511	Salary	494	1576
	M1 Task 3	536	1874		877	1693
	M4 Task 2	475	1490		469	1503
	M4 Task 3	448	1499		461	1474
	F1 Task 2	527	2053		563	2121
	F1 Task 3	542	2043		560	2109
	F4 Task 2	478	1957		591	1868
	F4 Task 3	536	1874		877	1693
Shell	M1 Task 2	433	1665	Shall	412	1659
	M1 Task 3	481	2107		713	1695
	M4 Task 2	399	1705		476	1686
	M4 Task 3	422	1695		458	1669
	F1 Task 2	531	2156		775	2065
	F1 Task 3	698	2084		573	2154
	F4 Task 2	487	1908		477	2024
	F4 Task 3	481	2107		713	1695
Telly	M1 Task 2	585	1721	Tally	465	1729
	M1 Task 3	677	1754		789	1722
	M4 Task 2	446	1653		501	1540
	M4 Task 3	448	1627		453	1630
	F1 Task 2	654	2369		695	2089
	F1 Task 3	648	2200		603	2215
	F4 Task 2	704	1837		552	1920
	F4 Task 3	677	1754		789	1722

Ellie	M1 Task 2	585	1536	Alley	495	1772
	M1 Task 3	729	1935		856	1925
	M4 Task 2	539	1670		473	1624
	M4 Task 3	516	1631		525	1587
	F1 Task 2	644	2365		684	2251
	F1 Task 3	700	2339		625	2372
	F4 Task 2	715	1911		681	2042
	F4 Task 3	729	1935		856	1925
Sell	M1 Task 2	533	1603	Sal	580	1526
	M1 Task 3	725	1858		734	1969
	M4 Task 2	428	1539		448	1547
	M4 Task 3	436	1946		463	1506
	F1 Task 2	652	2157		579	1990
	F1 Task 3	662	2016		671	2096
	F4 Task 2	602	1977		539	1991
	F4 Task 3	725	1858		734	1969
Mellow	M1 Task 2	535	1594	Mallow	444	1547
	M1 Task 3	611	1864		546	1711
	M4 Task 2	521	1565		481	1472
	M4 Task 3	519	1508		487	1462
	F1 Task 2	599	2082		634	2152
	F1 Task 3	632	2132		742	2188
	F4 Task 2	386	1844		595	1920
	F4 Task 3	611	1864		546	1711
Ellen	M1 Task 2	512	1623	Alan	552	1597
	M1 Task 3	799	2163		888	1804
	M4 Task 2	528	1643		474	1610
	M4 Task 3	551	1637		581	1650
	F1 Task 2	727	2055		misread	misread
	F1 Task 3	690	2242		656	2184
	F4 Task 2	874	1925		689	2016
	F4 Task 3	799	2163		888	1804
Kelvin	M1 Task 2	679	1712	Calvin	547	1693
	M1 Task 3	638	1748		463	1701
	M4 Task 2	496	1560		460	1652
	M4 Task 3	418	1671		496	1504
	F1 Task 2	606	2237		666	2108
	F1 Task 3	660	2111		658	2117
	F4 Task 2	640	1723		769	1692
	F4 Task 3	638	1748		463	1701

References

Boersma, Paul & David Weenink 2003. Praat Version 4.1.2: Doing Phonetics by Computer, a computer programme for speech analysis and synthesis for Windows. Institute of Phonetic Sciences, University of Amsterdam.

Buchanan, Hannah 2001, Neutralisation of DRESS and TRAP before /l/ in New Zealand English, Wellington Working Papers in Linguistics 13: 15-29.

Gordon, Matthew J. 2002, Investigating chain shifts and mergers. In J.K. Chambers, Peter Trudgill & Natalie Schilling-Estes (eds) Handbook of Language Variation and Change, Massachusetts: Blackwell, 254-266.

Horsfield, R. 2001. The Changing Vowels of New Zealand English. Honours Thesis, University of Otago.