A Doll on the Dole: Prelateral Length Mergers in Australian English

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Abstract

The effects of prelateral coarticulation on vowels in Australian English sometimes result in the reduction of spectral contrastiveness in vowel pairs. As a result, some speakers may struggle to distinguish minimal pairs that differ only in these vowels prelaterally, for instance realising both *doll* and *dole* as /dəʉl/. This pilot study investigates the effect of this context-induced merger by testing the accuracy and reaction time of 10 young Australian English speakers from Melbourne in an AXB discrimination and categorisation task. Participants struggled to distinguish some prelaterally merged vowel pairs more than others. There were also significant differences between the categorisation and discrimination results for front and back short/long vowel pairs.

Index Terms: prelateral coarticulation, lateral-final rimes, perception, Australian English.

1. Introduction

It is well known that changes in the perception of coarticulatory effects on phonemes can lead to sound change [1-5]. In English, prelateral coarticulation can lead to a reduction in acoustic and perceptual contrasts in some vowels [5-10]. This has led to a number of changes in English prelateral vowel contrasts, including the reduction of spectral contrast in the tense-lax FLEECE-KIT vowel pair in Standard Southern British English [11], the reduction of the POOL-PULL-POLE contrast in Ohio English [9], and the /el/~/æl/ merger in New Zealand and Melbourne English [12-16], which is of particular interest in relation to the participant population of the present study. In Australian English (AusE) specifically, prelateral coarticulation has been particularly important in triggering a number of sound changes besides the /el/~/æl/ merger [10], including the developing /ɐlC/~/ɔlC/ merger [17] and the reduction of spectral contrast in some prelateral vowel pairs [6], [18].

The AusE vowel inventory consists of 18 contrastive vowels, varying in both spectral and durational quality [19]. Within this inventory there are three vowel pairs which exhibit substantial allophonic overlap in prelateral contexts – /ʉː-ʊ/, /æɔ-æ/, /əʉ-ɔ/ (GOOSE-FOOT, MOUTH-TRAP, GOAT-CLOTH) [5], [8], [20]. These contrasts are spectrally reduced before /l/ such that there is little difference in vowel quality, though the length distinction between them may be maintained [6], [18], [21]. The length contrast is not always perceptible, however, as a result of ascribing the lengthening of the vowel to a coarticulatory effect of the subsequent /l/ on the preceding vowel. This leads to difficulties in disambiguating the vowel from the following /l/ [5]. As a result, /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/ may merge prelaterally, leading to the homophonous pronunciation of pairs like *doll* versus *dole* as /dəʉl/ [6], [21].

A number of studies have investigated this context-induced merger of AusE /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/. Szalay et al. [20] tested whether speakers of AusE could successfully transcribe words with these vowel contrasts using English orthography (i.e. *fool-full, howl-Hal,* etc.). They found that speakers generally struggled to correctly transcribe minimal pairs featuring vowel contrasts that they did not themselves produce. Szalay et al. [5], [8] similarly concluded that reduced perceptual contrast in these prelateral vowels may lead to a vowel merger in AusE, but did not find perception to be skewed towards a particular phonemic category in each pair (i.e. a skew towards interpreting an ambiguous vowel as a short or long vowel). These findings are informative, but Szalay et al.'s [5], [20] results were potentially affected by word-frequency effects [20] and the mixed use of real and nonce words [5], both of which are known to have confounding effects on speaker perception [22].

Design limitations aside, Szalay et al.'s findings suggest that prelateral context has a strong effect on the perception of /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/ in AusE. Given that changes in perception as a result of coarticulatory effects are often a precursor to sound change [1-4], further investigation into the perception of these prelateral contrasts may provide useful insight into emerging sound changes in Australian English. To that end, this paper investigated two research questions through an AXB discrimination task and a categorisation task:

1. To what extent is a merger of the vowel pairs /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/ underway prelaterally in the AusE of young Melbournians?
2. Is there a preference for interpreting vowels in each of these pairs as long or short where their length is ambiguous prelaterally?

2. Method

The present study was co-designed by the students in the 2024 Semester 1 subject LING40009 Seminars in Descriptive Linguistics at the School of Linguistics at the University of Melbourne. Data collection was undertaken by the first author, Geordie Kidd, Katie Carpenter, Felix Kimber, and Lizzie Kelly.

2.1 Participants

Ten native speakers of AusE (five female; four male; one other) participated in this pilot study. The participants ranged in age from 17-27 (*M* age = 21.5). All participants were born and raised in Melbourne to monolingual English-speaking parents and were not linguistically trained. None reported any reading, hearing, or speaking disorders. The ten participants were recruited through the first author's personal network. They were not paid for their participation. The study was approved by the University of Melbourne's human ethics committee (reference number: 2024-29383-52826-3).

2.2 Materials

Seven nonce words of the form *snVl* were used for both the discrimination and the categorisation experiments outlined below. Nonce words were chosen to avoid the potentially confounding effect of lexical frequency in aiding perception. The nonce words included the three short/long vowel pairs of interest here (/snæl-snæɔl, snɔl-snəʉl, snʊl-snʉːl/) as well as a control pair (/snɪl-snəʉl/). The stimulus material was produced by three Melbourne-raised native male speakers of AusE aged 22-23. The speakers were recorded in a quiet location. They were familiarised with the intended target nonce words through the presentation of real rhyme words and instructed to produce the target words in a clear, casual manner, as if speaking to a friend. The estimated average formant frequencies and rhyme lengths across all three speakers for the stimulus material are presented in *Table 1* below. Formant frequencies were estimated for the midpoint of the vowel. Rhyme lengths were measured given the difficulty of segmenting vowel + lateral coda sequences.

Table 1. *Estimated average formant frequency and rhyme length data across all three stimulus speakers for stimulus material used in the experiment.*

Word	*F1 (Hz)*	*F2 (Hz)*	*Rhyme length (ms)*
/snæl/	738	1575	298
/snæɔl/	645	1746	431
/snɔl/	559	1112	311
/snəʉl/	553	1119	465
/snʊl/	473	1112	247
/snʉːl/	448	1020	391
/snɪl/	503	1672	277

2.3 Procedures

Participants completed a categorisation task and an AXB discrimination task. This was done in order to determine whether participants are able to distinguish these prelateral vowel pairs when heard together (in the AXB discrimination task) and in isolation (in the categorisation task) to ascertain the degree of merger that may be underway, in line with research question 1. The order of perception tasks was randomised such that half of the participants began with the AXB task and half began with the categorisation task. Both tasks were created and run using Praat version 6.4.11 [23]. All participants completed the two tasks on a laptop or desktop computer in a quiet room using good quality headphones. Per participant randomisation was applied for all tasks.

2.3.1 Categorisation task

In the categorisation task, participants were shown a screen with seven real English words in English orthography. They then heard one of the seven *snVl* nonce words used in the AXB task and were asked to choose the corresponding English word which best rhymed with the nonce word. They were then asked to rate how well they thought the word they selected rhymed with the heard nonce word on a five-point Likert scale as a goodness-of-fit measure. The seven real English words used as rhymes for the nonce words were *pal, foul, doll, pole, bull, pool*, and *pill*. Potentially confounding effects of frequency [22] were reduced where possible, with a mean 16,278 parts per million in COCA [24] (range 9,198-42,491; SD 10,983). Words were selected which began with a labial consonant to minimise vowel-to-consonant coarticulation [25-26]. The exception to this was *doll*, which was chosen because it is more regularly pronounced with the short [ɔ] than the labial-initial *poll* (which is more often rendered [pəʉl]) and has a similar frequency to the other words selected for the study (10,794 for *doll*, cf. 31,129 for *poll*).

Participants completed a total of 63 trials, hearing each recording of each nonce word three times per speaker (7 nonce words x 3 speakers x 3 repetitions = 63). They completed a practice task with unrelated *snVl* nonce words prior to the experiment to ensure they understood the task. The participants were familiarised with the target words via a recording by a male 22-year-old native AusE speaker from Melbourne producing the seven English rhyming words. This was to ensure participants understood the pronunciation of each of the English words on screen before beginning the categorisation task (i.e. that they did not initially misread the categorisation target words). Recordings of this speaker were not used elsewhere in the experimental design.

2.3.2 Discrimination task

In the AXB discrimination task, participants heard a sequence of three stimuli (A, X, B) where the middle stimulus was phonologically identical to either the first (A) or third stimulus (B). Each stimulus was produced by a different one of the three stimulus speakers such that participants were forced to identify phonological categories to complete the task, rather than relying on speaker-specific voice patterns for identification. The ordering of speakers was randomised. An interstimulus length of 300ms and intergroup pause of 500ms were used.

Participants completed a total of 96 trials examining four word-pairs – the three target pairs (/snæl-snæɔl, snɔl-snəʉl, snʊl-snʉːl/) and a control (/snɪl-snəʉl/). Each pair was presented 24 times (2 target positions x 2 X values x 6 speaker configurations = 24). Participants completed a practice task with unrelated *snVl* nonce words prior to the main experiment to ensure they understood the task.

2.4 Data analysis

The discrimination task yielded data in the form of discrimination accuracy and reaction time (RT), collected automatically from Praat. The categorisation task yielded perceptual categorisation accuracy data and goodness-of-fit ratings for each categorised *snVl* word to the chosen English rhyme, collected automatically from Praat. Repeated measures ANOVAs were conducted for the AXB task results using JASP [27]. Accuracy and goodness ratings in the categorisation task were compared in a confusion matrix.

3. Results

3.1. Results of categorisation task

The results for the categorisation task are presented in the confusion matrix in *Table 2* below. Percentage correct target categorisations are presented in bold on the diagonal with the mean goodness-of-fit rating in parentheses.

Almost all non-target categorisations were of the other length value in the target pair (e.g. incorrectly categorising /snʊl/ as rhyming with *pool* rather than *bull*, etc.). The exceptions were /snɔl/ and /snəʉl/, notably the least accurate pair, which were also incorrectly categorised as rhyming with *bull* (7%) and *foul* (2%) respectively. There are clear asymmetries in accuracy within each short-long vowel pair. For the front pair /snæl-snæɔl/, participants were more accurate identifying the short

vowel. The opposite is true for the two back vowel pairs, /snɔl-snəʉl/ and /snʊl-snʉːl/, where participants were more accurate identifying the long vowel.

Table 2. *Confusion matrix giving percentage accuracy for each response in the categorisation task. Correct responses are bolded, with mean goodness ratings shown in brackets. Responses which only occurred once are not included.*

		Response						
		/snɪl/ (control)	/snæl/	/snæɔl/	/snɔl/	/snɔʉl/	/snʊl/	/snʉːl/
Stimulus	/snɪl/ (control)	**99 (4.22)**						
	/snæl/		**72 (3.57)**	26 (3.17)				
	/snæɔl/		41 (3.14)	**58 (3.67)**				
	/snɔl/				**42 (4.05)**	47 (3.48)	7 (1.67)	
	/snɔʉl/			2 (2.50)	20 (3.89)	**76 (3.96)**		
	/snʊl/						**69 (3.26)**	30 (3.48)
	/snʉːl/						22 (3.30)	**77 (3.83)**

3.2 Results of AXB discrimination task

The discrimination accuracy level of each vowel contrast is presented in *Figure 1*. A repeated measures ANOVA was performed to assess the effect of vowel contrast on discrimination accuracy. Since Mauchly's test of sphericity was significant, Greenhouse-Geisser correction was used. This showed that discrimination accuracy differed significantly $F(2.402,9)=11.692$, $p<0.001$ across the four contrasts. Post hoc testing using Bonferroni correction showed that the control pair is more accurately discriminated than the /snæl-snæɔl/ pair (*M* difference = −0.161, $p = 0.003$) and the /snʊl-snʉːl/ pair (*M* difference = −0.108, $p = 0.013$). Differences between the control and the /snɔl-snəʉl/ pair were not significant.

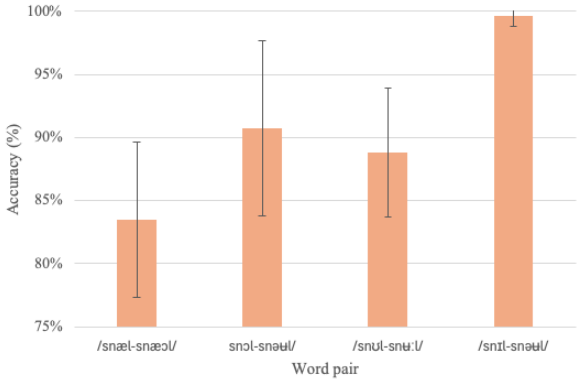

Figure 1. *Descriptive plot showing the effect of word pair on accuracy. Confidence interval of 95% shown.*

There was also a statistically significant difference in mean reaction time for the four contrasts $F(2.147,9)=4.075$, $p=0.031$, shown in *Figure 2*. Bonferroni corrected post-hoc comparisons showed that participants were more quickly able to distinguish the control pair than the /snɔl-snəʉl/ pair (*M* difference = 204ms, $p = 0.022$) and the /snʊl-snʉːl/ pair (*M* difference = 347ms, $p = 0.023$). Differences between the control and the /snæl-snæɔl/ pair were not significant.

A third repeated measures ANOVA was performed to compare the effect of the length of the X vowel on accuracy within each target pair (e.g. for the /snæl-snæɔl/ pair, comparing whether participants were more accurate if X was /snæl/ or /snæɔl/, etc.), following Thomas and Hardy [16]. Since Mauchly's test of sphericity was significant, Huynh-Feldt correction was used. Length of the X vowel had a significant effect on discriminating the /snæl-snæɔl/ vowel pair, as shown in *Figure 3*, but not /snɔl-snəʉl/ or /snʊl-snʉːl/ (*M* difference = –0.168, $p < .001$). For the /snæl-snæɔl/ pair, participants were significantly more accurate where X was a long vowel (/snæɔl/). This is interesting in light of the categorisation task, where participants were more accurate in categorising /snæl/ than /snæɔl/.

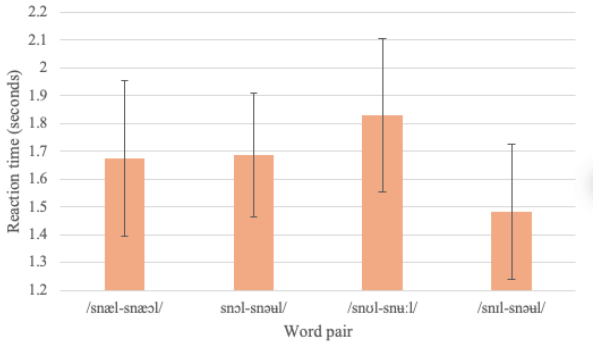

Figure 2. *Descriptive plot showing the effect of word pair on reaction time. Confidence interval of 95% shown.*

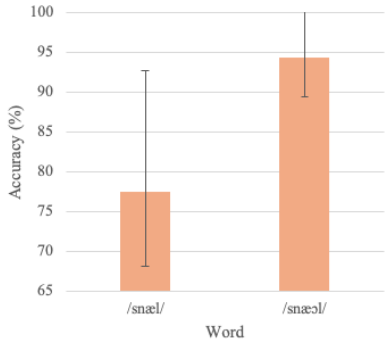

Figure 3. *Descriptive plot showing the effect of length of the X vowel on accuracy for the* /snæl-snæɔl/ *pair. Confidence interval of 95% shown.*

A further repeated measures ANOVA was conducted to see if there was a statistically significant effect of ordering on accuracy (e.g. if participants were more accurate at discriminating a long vowel if they heard a long vowel first). No statistically significant effect was found.

4. Discussion

The present study investigated the emerging context-dependent merger of the short/long vowel pairs /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/ in the variety of Australian English spoken by young people in Melbourne.

The categorisation task presented in Section 3.1 indicates that participants find it difficult to accurately categorise /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/ vowels prelaterally. For the front /æ-æɔ/ pair, participants were more accurate in categorising the short /æ/ vowel. The opposite was true for the back /ʉː-ʊ/ and /əʉ-ɔ/ pairs, where participants were more accurate in categorising the long /ʉː/ and /əʉ/ vowels.

The AXB discrimination task results presented in Section 3.2 indicate that participants also find it difficult to accurately

discriminate /ʉː-ʊ/ and /æɔ-æ/ vowels prelaterally, consistent with the results of the categorisation task. The discrimination task also indicated that participants were more accurate where the target vowel was long for the /snæl-snæɔl/ pair, which is the opposite finding to the categorisation task. No statistically significant effect of length on accuracy was found for the /snɔl-snəʉl/ or /snʊl-snʉːl/ vowels.

In most psycholinguistic experiments, reaction times (RTs) are assumed to indicate how difficult participants find a task to complete. Faster RTs indicate that a task is easy; longer RTs indicate that a task is difficult. RTs for the /ʉː-ʊ/, /əʉ-ɔ/, and /æɔ-æ/ pairs in the discrimination task were all longer (significance levels reached only for the first two pairs) when compared to the control, suggesting that participants find it difficult to discriminate these vowels prelaterally.

Together, these results suggest that a complete merger has not occurred for prelateral /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/ in the AusE of all young people in Melbourne. Nevertheless, the decreased accuracy of discrimination and categorisation in these pairs compared with the control suggests that a partial merger may be underway, answering research question 1. Specifically, comparatively high accuracy in the discrimination task compared to the categorisation task suggests that participants can still hear a difference in the target vowels when presented together, as would be expected if no merger has occurred. The lower accuracy of the categorisation task is difficult to explain, however, unless these pairs have undergone some degree of merger.

Despite the methodological differences (real versus nonce word stimuli), the results here are consistent with the findings of Szalay et al. [5], [8], [20]. We find evidence that speakers struggle to discriminate differences in AusE length pairs in prelateral contexts even when accounting for the confounding factors of frequency and mixed use of nonce and real words in the experimental design, giving further credence to Szalay et al.'s previous findings.

In relation to research question 2, our data may suggest that participants interpret an ambiguous vowel as long prelaterally. The participants in the present study tend to be more accurate in categorising the long back /ʉː/ and /əʉ/ vowels and discriminating the long front /æɔ/ vowel. These findings do not necessarily support Szalay et al.'s [5] claim that there is no preference for a particular length where it is difficult to distinguish a vowel in prelateral contexts. This potential preference for a long vowel may be a result of partial merger, where the merged vowel in the speech of the participants is closer to a long vowel target, as we might expect given the anecdotal preference for pronouncing *doll* and *poll* as /Cəʉl/. As a result, participants can more accurately categorise the long vowel because it more closely matches their own merged vowel, and are less accurate in categorising the short vowel, which does not occur as often in their speech. The results here may therefore resemble other cases of partial merger, such as the /el/~/æl/ merger in New Zealand English [16], as well as Szalay et al.'s previous findings [20]. Production data from participants would be required to investigate this further.

This does not explain why participants were more accurate in categorising the short /snæl/ vowel in the categorisation task, however. This could potentially be explained by appealing to hypercorrection in the sense of Ohala [4] as a result of compensation for /l/ vocalisation. /l/ vocalisation is a common process in English which results in the realisation of /l/ as a high back vowel /ʊ/ and is known to affect speech sound perception [8], [10], [31-33]. Participants may thus be interpreting the back vowel in /snæɔl/ as a vocalised /l/ (e.g. [snæɔʊ]) and correspondingly overcorrect their perception to /snæl/. Given that /snæl-snæɔl/ begins with a front vowel target, there is a greater distinction between the target nucleus and the lateral when compared to the /snɔl-snəʉl/ or /snʊl-snʉːl/ back vowel pairs. As a result, it is possible that the diphthong is camouflaged by the /æ/ to /l/ trajectory such that participants are more susceptible to overcorrect for the effects of /l/ coarticulation in this front vowel than for the back vowels.

It is also possible that what appears to be a preference for interpreting an ambiguous vowel as long could in fact be explained by neighbourhood effects – e.g. participants may have been more accurate in discriminating the long /snʉːl/ nonce word than the short /snʊl/ because more words in English end in /-ʉːl/ (*fool, tool, cool, drool, stool,* etc.) than /-ʊl/ (*full, bull,* etc.). Possible neighbourhood effects were not specifically accounted for in the experimental design here, and thus it is difficult to determine with certainty what is motivating this possible preference for long vowels. Future experimental work would benefit from including both production data and accounting for neighbourhood effects to better explore this behaviour.

A further shortcoming in our experimental design was the decision to avoid minimal pairs in the categorisation task target rhymes (e.g. *doll* vs *pole* for the /snɔl-snəʉl/ pair rather than *doll* vs *dole*), as this increased the difficulty of the task such that accuracy was substantially lower than has been found in other studies. Half of the participants had an accuracy of lower than 50% for /snɔl/. Participants therefore found distinguishing the /snɔl-snəʉl/ pair particularly difficult. This may be a consequence of both *doll* and *pole* being realised as /Cəʉl/ for the participants, with the phonological shape of *doll* being more ambiguous as a result of the possible merger that is the focus of this paper. As a result, participants perhaps prefer the more familiar word *pole*, resulting in a much lower than 50% accuracy for /snɔl/. Future experimentation would thus benefit from deliberately incorporating minimal pairs in the experimental design – e.g. asking participants to rhyme with either *doll* or *dole*, rather than *doll* and *pole*.

5. Conclusions

Coarticulatory effects of /l/ on vowel length may be leading to a merger of the long-short /ʉː-ʊ/, /æɔ-æ/, and /əʉ-ɔ/vowel pairs prelaterally in AusE. In particular, speakers of AusE may have a general preference for perceiving these vowels as long where their length is ambiguous prelaterally. This may be a result of production influencing perception, in line with Szalay et al.'s [20] findings. This preference may be confounded by the effects of hypercorrection for /l/ coarticulation, which more noticeably affects front vowels than back vowels. We thus find there to be a difference in the categorisation and discrimination of front vs back short/long vowel pairs in prelateral contexts which merits further investigation.

These findings contribute to a growing body of research on the coarticulatory effects of /l/ on vowel production in English and support a theory of sound change where reinterpretation of coarticulatory effects leads to language variation [1-5]. Future research on this vowel merger in AusE would benefit from comparing perception and production data, especially in light of Szalay et al.'s [20] findings that perception of durational contrasts in prelateral contexts correlates with production of those contrasts. Future perception experiments should also take into account the confounding effects of minimal pairs in categorisation tasks and neighbourhood effects in the design of nonce words.

6. Method

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