

# THE [æ]NDS OF THE EARTH: AN INVESTIGATION OF THE DRESS AND TRAP VOWELS IN NORTHERN QUEENSLAND

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## ABSTRACT

Acoustic studies of Australian regional dialects have predominantly focused on the southern varieties of Australian English (AusE). This study presents formant frequency data for 10 female and 7 male Northern Queensland (NQ) speakers. Specifically the /e/ and /æ/ vowels in pre-lateral and pre-nasal conditions were analysed and compared with baseline /e/ and /æ/ values measured from controlled /hVd/ frames. The results reveal that for some speakers /e/ converges with /æ/ pre-laterally however for other speakers the two phonemes remain distinct. Pre-nasally the /e/ and /æ/ contrast is completely neutralised in the F1/F2 plane. However duration may serve as a contrastive cue to differentiate between two vowel categories, with /æ/ vowels tending to increase in duration pre-nasally.

**Keywords:** Australian English, regional variation, lateral, nasal

## 1. INTRODUCTION

Accent variability in Australian English (AusE) was previously described chiefly along the continuum of Broad, General and Cultivated [19]. This variability was primarily associated with an individual's production of AusE vowels [7]. These categories were primarily sociological and not linked to geographic region. Currently these categories are less helpful due to the significant changes undergone by the AusE vowel system and the declining use of the Broad and Cultivated varieties [6, 10, 11]. As a result recent studies have been undertaken to determine whether there is variability in the pronunciation of AusE and have found that there is some variation in the Australian accent and that it can be linked to region [1, 3, 5, 6, 7, 10, 14, 15, 16, 17].

### 1.1. /e/ and /æ/ in pre-lateral environments

Regional variation has been observed in the pronunciation of /e/ and /æ/ non-/hVd/ environments. Cox and Palethorpe [7] analysed the speech of rural adolescent girls living in three towns in the state of

New South Wales, Australia (NSW) and one town in the state of Victoria, Australia and found that /e/ merges with /æ/ pre-laterally for Victorian speakers but not in the speech of participants from NSW. They concluded [7, pg 12] that their results "provide evidence for regional variation in AusE that can be attributed to state affiliation." Loakes and her collaborators [14, 15, 16, 17] have extensively examined the /e/-/æ/ sound change and also found regional effects both acoustically and perceptually. This merger occurs in Victoria and is believed to be motivated by the interaction of increasing lateral velarisation, increasing vowel lowering and misperception/misparing of the phonetic signal. Overseas it has been noted that a merger of /e/ and /æ/ occurs before /l/ in the closely related New Zealand English dialect [2].

### 1.2. /e/ and /æ/ in pre-nasal environments

Many dialects of English demonstrate an allophonic raising and fronting of /æ/ in pre-nasal contexts [13, 18]. In AusE there have been a number of studies across more than 100 years about the nasalisation of /æ/ [9]. Cox and Palethorpe [8] have previously found that for young female Sydney speakers there was a phonetic raising of the nasal allophone which created an extensive allophonic split in the production of nasalised and oral /æ/. Mielke et al. [18, pg 333] has suggested that "nasalization has a strong effect on F1-lowering in low vowels, altering their perceived height and may also raise F2 for low vowels."

### 1.3. Aims

Whilst both of these phonetic environments have been well studied in other dialects of English, there is little data available for AusE from outside the states of Victoria and NSW. As a consequence, examining one of the northernmost extremities of Australia will provide an interesting counterpoint to the current discussion of regional variation in AusE. To contribute to the ongoing work, the present study provides formant frequency values for /e/ and /æ/

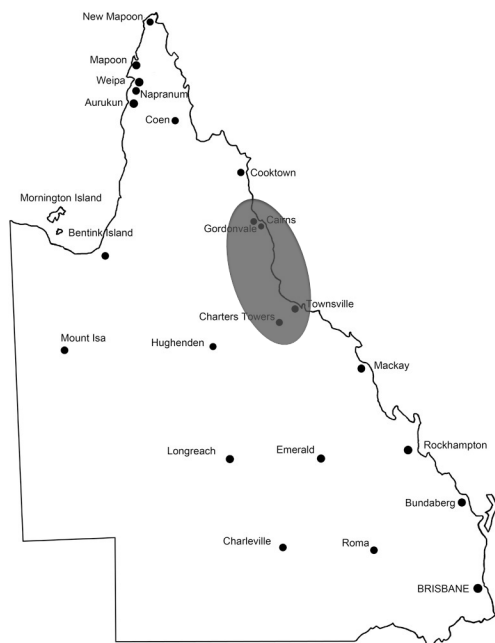
from young NQ speakers in three conditions, /hVd/, /CVI/ and /CVn/. The study aims to draw attention to a regional dialect of Australia and provide experimental phonetic data relating to it.

## 2. METHODOLOGY

### 2.1. Participants

10 females and 7 males between the ages of 17 and 22 (mean age 18.1 and 18.6 respectively) were recruited through James Cook University in Townsville, Queensland. Subjects selected for the present study were born in Australia and had lived in NQ (defined as the region extending from Townsville in the south to Cairns in the north and west to the Atherton Tablelands) for at least the past 10 years (see Fig. 1).

**Figure 1:** Map of North Queensland.



### 2.2. Data Collection

Speakers read 13 AusE vowels in the fully stressed /hVd/ contexts in citation from flash cards in order to create a NQ vowel space. In addition five pairs of words contrasting /e/ and /æ/ were also elicited in order to produce the contexts for /CVI/ and /CVn/. In total of 33 words were written on flash cards. Each participant read through the flash cards twice, shuffling between each turn and between each participant. Speakers were recorded with a Zoom iQ5 Mid-side (M-S) stereo mic. If a word was produced incorrectly, the participant was asked to repeat it.

### 2.3. Analysis

Speech data were sampled at 48kHz with 16 bit resolution. Audio data were first processed using the WebMAUS automatic aligner [12, 20] for which an AusE model is available. The automatically generated annotations and formant trajectories were manually checked and hand corrected in the EMU-webApp [22]. The vowel target for /e/ and /æ/ was identified with the steady state portion of each vowel. [1, 4]. Data from the first two formants (F1 and F2) were extracted in three conditions /hVd/, /CVI/, and /CVn/. For all three conditions the formant frequency means and standard deviations were calculated for each vowel represented in that condition. Formant plots were then created for the data based on the mean F1 and F2 values for vowel targets. This analysis was repeated for both the females and males in the study due to significant difference due to gender. Mean formant values were compared in each condition with a Student's t-test being conducted to ascertain whether observed differences were significant.

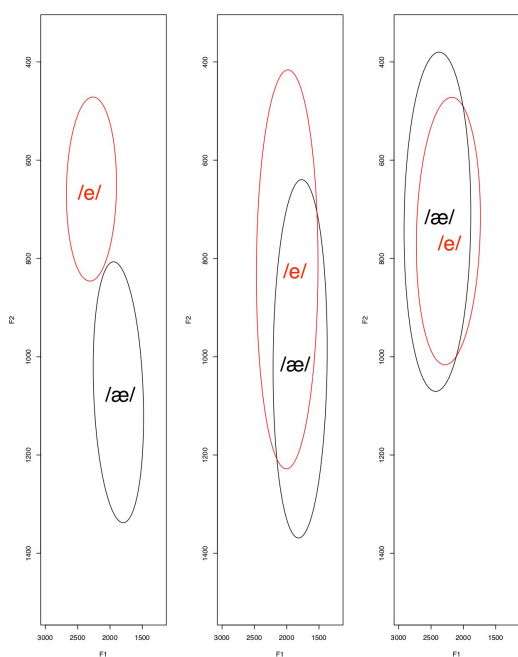
## 3. RESULTS

In Fig. 2 and 3 /e/ and /æ/ are plotted utilising vowel ellipses with 95% confidence regions in the three conditions. The initial /hVd/ condition show clear separation of the two realisations in the F1/F2 plane with /e/ located at the mid close position whilst /æ/ occupies a near open location.

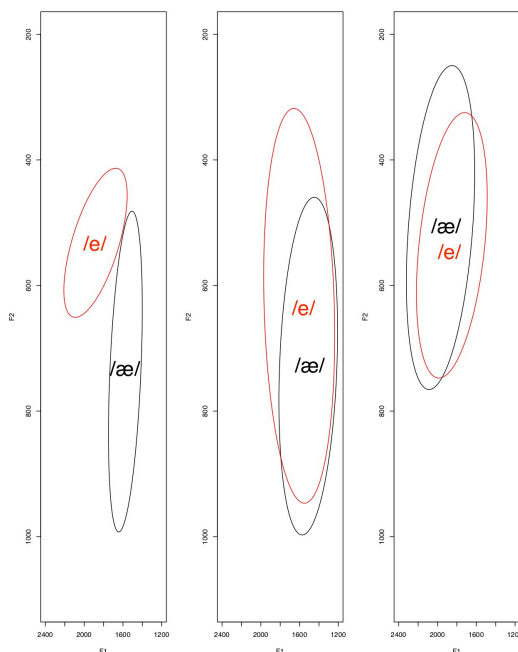
### 3.1. CVI

In the /CVI/ condition the /e/ lowers relative to the /hVd/ condition. There was a significant difference in mean female F1 and F2 frequencies,  $t(118)=-4.3, p<0.001$  and  $t(118)=6.4, p<0.001$  respectively. This increase in mean F1 and F2 frequencies was accompanied by an increase in the standard deviation indicating greater variability in production. In contrast in the same condition /æ/ did not significantly alter in its F1 position,  $t(117)=1.9, p=0.061$  or F2,  $t(117)=1.9, p=0.066$ . These trends were evident in the male data (/e/ F1  $t(82)=-2.9, p<0.005$ , F2  $t(82)=6.5, p<0.001$ ; /æ/ F1  $t(82)=0.27, p=0.785$ , F2  $t(82)=1.9, p=0.065$ ). There is thus an increasing level of overlap in the phonetic realisation of these categories in this condition as seen in Fig. 2 and 3. However, despite the movement of /e/ pre-laterally and increased variability in the data, the two phonological categories maintain their distinctiveness with statistically significant differences between /e/ and /æ/ in both F1 and F2 mean values (female F1

**Figure 2:** NQ female /æ/ and /e/ vowel ellipses in /hVd/, /CVl/ and /CVn/ conditions.



**Figure 3:** NQ male /æ/ and /e/ vowel ellipses in /hVd/, /CVl/ and /CVn/ conditions.



t(198)=-8.2, p<0.001 and F2 t(198)=7.7, p<0.001; male F1 t(138)=-4.8, p<0.001 and F2 t(138)=4.0,

p<0.001).

When examined by speaker, NQ speakers exhibited a large degree of individual variation. Three female speakers (30%) and two male speakers (29%) showed a full merge of /e/ and /æ/ pre-laterally. The other participants had statistically different (p<0.05) realisations.

### 3.2. CVn

In the /CVn/ condition the /æ/ raises comparative to the /hVd/ condition. There was a significant difference in F1 mean frequency in the /CVn/ condition compared to the /hVd/ condition for both female and male speakers respectively: t(111)=10.1, p<0.001 and t(80)=7.4, p<0.001. The /æ/ vowel was additionally realised as a more fronted variation with a significant difference in F2 from the /hVd/ condition, female t(111)=-10.4, p<0.001 and male t(80)=-9.9, p<0.001. There was individual variation in this realisation, with 4 female (40%) and 2 male (29%) speakers recording significant differences (p<0.05) between their /e/ and /æ/ realisations pre-nasally.

### 3.3. Duration

As a consequence of these results the mean duration of the /e/ and /æ/ vowels in the three conditions was explored, as duration has previously been recognised as providing contrasting vowel cues in overlapping vowel categories [21]. As seen in Fig. 4 and 5 in the /hVd/ environment the expected difference in duration between the typologically short and long vowel is evident with significant difference in duration evident for both females and males.

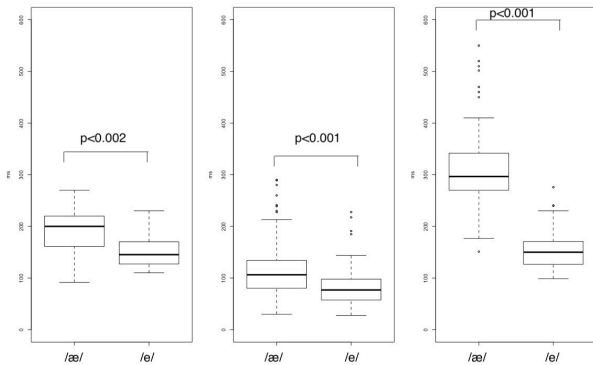
In the /CVl/ condition both vowels are significantly shorter in length than in the /hVd/ condition (/e/ female t(119)=9.0, p<0.001, male t(83)=4.7, p<0.001 and /æ/ female t(118)=6.0, p<0.001, male t(83)=5.2, p<0.001). Despite the reduction in length a significant difference duration between /e/ and /æ/ is still maintained.

The duration of /e/ in the /CVn/ condition has similar mean lengths as those recorded in the /hVd/ condition, female: 149ms vs. 151ms, t(120)=0.4, p=0.679; male: 134ms vs. 141ms, t(83)=0.8, p=0.418. In contrast the duration of /æ/ in the /CVn/ condition increases from means of 191ms for females and 183ms for males to 309ms and 258ms respectively.

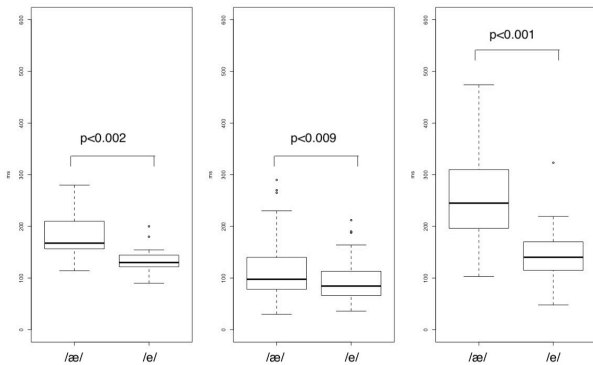
## 4. DISCUSSION

The present data reveals that AusE has more regional variation than previously understood. The

**Figure 4:** NQ female /æ/ and /e/ vowel duration in /hVd/, /CVI/ and /CVn/ conditions.



**Figure 5:** NQ male /æ/ and /e/ vowel duration in /hVd/, /CVI/ and /CVn/ conditions.



lowering of /e/ before /l/ has previously only been described in Victoria [7, 16]. Loakes et al. [16] found that not all speakers in Victoria merge /e/ with /æ/ pre-laterally, but in fact some combine, some maintain and some transpose. NQ data demonstrates a similar pattern where some speakers have a realisation that overlaps /e/ with /æ/ in this condition but some maintain the differentiation. However in contrast to Victoria, where 70% of speakers in the study were found to have combined these categories, in NQ 70% of speakers were found to have maintained distinctive realisations. The results show that this pattern is not dominant in NQ, with a large proportion of speakers continuing to maintain the contrast. However it is suggested that based on the large degree of variability in the /CVI/ condition some NQ speakers may be in the process of merging these categories akin to speakers in Victoria. Future research longitudinally will need to be conducted in order to ascertain this. The present duration data shows that both vowels have lower mean durations

in the /CVI/ context. It is hypothesised that this is the co-articulatory effect of the following velar lateral rather than an attempt to utilise duration to disambiguate the vowel categories. However further research is needed to determine whether dimensions other than vowel quality such as duration are being utilised to produce and perceive the contrast. Perception studies are also required to identify whether those who do combine these categories in NQ have a bias in perceiving the contrast. Cox and Palethorpe [8] have previously found that /æ/ raised and fronted pre-nasally for a proportion (66%) of young female adults from Sydney. The present study found similar proportions of both males and females from NQ also raised and fronted /æ/ pre-nasally. In both the /hVd/ and /CVn/ conditions, /æ/ is significantly more fronted than /e/ ( $p < 0.001$ ) whilst /e/ does not significantly differ in this dimension. In the /hVd/ and /CVn/ conditions /e/ has been found to be significantly phonetically raised from /æ/ pre-nasally [8]. This contrasts with the current findings where /e/ and /æ/ in the /CVn/ condition are not significantly different in mean F1 values. Mean duration of /æ/ was also found to have increased in the /CVn/ condition in line with previous results from another AusE dialect [8]. This suggests that speakers from NQ are utilising duration in a similar way to differentiate between two merged vowel categories.

## 5. CONCLUSION

This study has explored regional variation in Australia by focusing on one of the geographic extremes of the continent. It provides formant frequency data for both female and male NQ speakers specifically focusing on /e/ and /æ/ in conditions known for regional differences. Some NQ speakers demonstrate features not seen before outside of Victoria. NQ speakers also utilise a strategy evident in NSW to differentiate between /e/ and /æ/ pre-nasally. This work aids in our understanding of the differences apparent in AusE based on region and in the future may provide a basis for looking at any trends or patterns of change in the vowels of NQ.

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