Positional Allophony, Ethnolectal Variation and /l/ Darkness in Australian English

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Abstract

English laterals exhibit acoustic variability, often described as having "clear" or "dark" allophones determined by syllable position. Previous accounts suggest that Australian English /l/ is dark in all positional contexts, but this is understudied, and it is unclear how speaker background may affect lateral production. This study presents an acoustic analysis of /l/ produced in citation-form in different syllable positions by speakers with various heritage language backgrounds. Results show that speakers from all language backgrounds tested produce a positional distinction between clear and dark /l/, but that those with English-only backgrounds produced darker syllable-initial /l/s compared to those with non-English speaking backgrounds.

Index Terms: lateral darkness, sociophonetics, acoustics, ethnolectal variability, Australian English, allophony.

1. Introduction

1.1. Positional allophony of /l/ in English

Variation in the formant structure of the English alveolar lateral approximant is documented in many varieties [1, 2]. Broadly speaking, this variation is a continuum ranging from "clear" to "dark", with clear variants exhibiting higher F2 and lower F1 than dark variants. This variability is related to the extent of velarisation/pharyngealisation as well as the relative timing of apical and dorsal gestures involved in /l/ articulation, with clear /l/ characterised as "/i/-like" and dark /l/ as "/u/-like" respectively [1, 3, 4].

The distribution of clear and dark variants is usually understood to vary by syllable position, with clear /l/ occurring syllable-initially and dark /l/ syllable-finally, but as [5] shows the patterning of positional allophony differs between English varieties: some have notably clear onset /l/s contrasting with dark coda /l/s; others have intermediately dark onset /l/s contrasting with yet darker coda /l/s; others still entirely lack positional distinctions [6, 7, 8]. The picture is further complicated by sociolinguistic factors such as speakers' heritage language background, gender, and social class, which may additionally affect /l/ realisation [6, 9, 10, 11].

Laterals are involved in various coarticulatory processes in English that have attracted considerable attention in the literature, with studies finding both that darker /l/s are more resistant to coarticulatory influence from other vowels than lighter /l/s, and that darker /l/s may induce coarticulatory changes in adjacent vowel segments [3, 12, 13]. In Australian English (AusE), impressionistically described as having dark /l/s in all contexts [14, 15], postvocalic dark /l/ is implicated in various spectral contrast reductions, including the vowels in pairs like *feel-fill*, *fool-full*, *dole-doll*, *howl-Hal* and (for some Victorian speakers) *celery-salary* [16, 17]. Overall, the influence of coarticulatory processes in progressing sound change is well-documented [e.g., 18], but /l/ darkness as a potential contributor to this is understudied in AusE.

Though limited, some acoustic research exists on positional variability of /l/ in AusE. [19] finds that Victorian AusE speakers produce significantly darker coda /l/s than onset /l/s. Looking at intervocalic /l/s, [20] found that only 1 of their 13 participants consistently produced clear /l/s in this context. Research on /l/ darkness in AusE using data from informants who reside outside of Victoria is scarce. Additionally, we lack understanding of the acoustic characteristics of /l/ in a broad variety of positional contexts in AusE. We therefore seek to address these gaps in the current analysis.

1.2. Ethnolectal variability of /l/ darkness

Variation in /l/ darkness associated with speaker heritage language background is well-described in literature on several English dialects outside Australia. Some of this work is concerned with the acquisition of canonical English positional allophony among bilingual children [21, 22, 23], whereas other research focuses on understanding differences in positional allophony as an example of ethnolectal variation [9, 10, 11, 19, 24]. For example, literature from the United Kingdom has consistently found that speakers of South Asian heritage (e.g. with heritage languages such as Punjabi and Sylheti) tend to exhibit a canonically English-like pattern of /l/ positional allophony but with "hyper-clear" /l/ in onset contexts, even in areas where the local variety has dark /l/ onset /l/s, thereby producing a much more marked distinction between onset and coda /l/ variants [10, 11, 24]. It is presumed that this stems from heritage language transfer, but its documented persistence through multiple generations of speakers, including those who do not report any use of a heritage language, may suggest that a supralocal British Asian type of /l/ positional allophony has developed that coexists with local patterns used by Anglo-heritage speakers [9, 23, 24].

In the Australian context, [19] investigated /l/ darkness in adult AusE speakers of both Anglo-Celtic heritage and Lebanese heritage, finding that both groups produced a positional distinction between onset and coda /l/, as expected. This study made use of a social network score that measured the extent to which a Lebanese-Australian informant's social network comprised of Lebanese versus non-Lebanese members, revealing additional insights: male speakers with more densely Lebanese social networks produced clearer onset /l/s, and female speakers with more densely Lebanese social networks produced both clearer onset /l/s and darker coda /l/s. This suggests that /l/ darkness carries broader socioindexical associations reflective of a speaker's attitudes towards their heritage language background that go beyond simple effects of language transfer, and which are modulated by gender [19, 25].

Ethnolectal variation in /l/ darkness has otherwise received little inquiry in the AusE literature, presenting an interesting gap to investigate given the comparatively small body of work

on this topic compared to that in other Anglophone countries. The linguistic makeup of Australian communities has changed substantially in recent decades, with cities such as Sydney having become particularly diverse [26]. Recent census data show that 64% of Greater Sydney residents have at least one parent born overseas, with languages other than English used in 42% of households [27]. Investigating /l/ darkness in the context of this increase in cultural and linguistic diversity is also key in motivating the present analysis.

1.3. Research questions and predictions

This study seeks to examine the following:

1) How do the acoustic qualities of /l/ vary in different positional contexts in AusE?
2) Is there evidence that AusE /l/ is dark in all positional contexts, as has been previously claimed?
3) Do patterns of positional allophony vary between speakers with different heritage language backgrounds?

We seek to answer these questions through an acoustic analysis of lateral variation in AusE. We first expect that syllable-initial /l/ will be clearer than syllable-final /l/ [19]. It is more difficult to predict how word-medial laterals will behave since there is less acoustic evidence available for these contexts, though some research suggests they behave more similarly to onset /l/s than coda /l/s [6, 28].

Since previous impressionistic descriptions suggest that mainstream AusE /l/ may be dark regardless of positional context [14, 15], we may expect darker onset /l/s for participants in our sample with exclusively monolingual English-speaking heritage. On the other hand, based on the aforementioned research from both AusE [19] and several UK English varieties [7, 9, 22], we also hypothesise that speakers in this study with Arabic and South Asian linguistic heritages will have clearer word-initial /l/s than speakers with solely English-speaking heritage. For participants with Chinese or Vietnamese language heritage, phonotactic evidence from their heritage language may lead us to predict that speakers with these linguistic heritages also have clearer onset /l/s, since Chinese [29] and Vietnamese [30] varieties do not allow coda /l/. Khmer does allow coda /l/ [31], but we do not have predictions as to how this may impact the realisation of onset /l/ among participants with Khmer-speaking heritage.

2. Methods

2.1. Materials

2.1.1. Data collection

This study uses a subset of data from the MAE-VoiS corpus [32]. All participants completed the same tasks, consisting of a picture-naming task with single words and short phrases elicited from images presented on a computer screen. Conversational data was also recorded but is not analysed here. Some participants (39 in total) were recorded remotely due to COVID-19 pandemic restrictions; the remainder were recorded in-person. Most participants were recorded at their schools, with a minority being recorded in other quiet settings such as their homes or local libraries.

2.1.2. Speakers

Participants were 148 high school students aged 15-18, recruited from different schools in the Sydney metropolitan area. They had completed all their schooling in Australia and all except 3 were also Australian-born; all participants were native speakers of AusE [32]. Participants were divided into 5 groups according to their heritage language background: monolingual English (22M, 33F), Arabic (15M, 5F), Chinese (including Mandarin and Cantonese) (9M, 11F), South-East Asian (Vietnamese and Khmer) (15M, 20F) and South Asian (including various Indo-Aryan and Dravidian languages) (12M, 7F). These groups were determined based on details of family language background provided by the participants and their guardian(s) collected through a demographic survey [32]. Most (but not all) of the speakers in the English heritage group were from Sydney's Northern Beaches, a largely homogeneous and monolingual area, whereas speakers from the other heritage language groups all resided in more culturally diverse areas in Sydney's west and south-west suburbs. Those in the Arabic, Chinese, South-East Asian and South Asian heritage language groups either spoke one of the languages in these respective groups at home or had exposure to that language through a parent/guardian. The non-English heritage language groups also reflect to varying degrees the communities in which these speakers reside—for example, most of those in the South-East Asian group are from the same area, as are those in the South Asian group, and so on, though there is not a one-to-one correspondence between language heritage group and area of residence [32]. The areas different speakers are recruited from vary demographically in other ways as well (such as general social class makeup), but these factors are beyond the scope of the current initial analysis.

2.1.3. /l/ items and positional contexts

Laterals analysed here were extracted from recordings of 36 single words and 11 short phrases. The laterals occurred in word-initial, medial, and final positional contexts. Word-medial /l/s, which we term *trochaic* (i.e. post-accentual—using terminology from [8, 9]) in the current study, are separated to assess whether they are acoustically more similar to onset or coda /l/s. We also categorised final /l/s occurring in an unstressed syllable (as in *bottle*) separately from those preceded by a stressed vowel (as in *doll*) since in the former context the lateral may form the syllable nucleus. This gives four /l/ positional contexts, shown in table 1, with each exemplified by one of the target words for clarity. 6438 /l/ tokens are analysed here, 3275 produced by female speakers and 3163 by male speakers.

Table 1. *Positional contexts of /l/ analysed.*

/l/ position	*N* items	Exemplar
initial	12	*leg*
final	10	*doll*
medial trochaic	9	*alligator*
syllabic /l/	6	*bottle*

2.2. Data preparation and analysis

2.2.1. Measuring /l/ darkness

F1 and F2 values were extracted at the midpoint of /l/ in an emuR database [33] using R [34] in RStudio [35]. This emuR database allowed inspection of all corpus items containing /l/ using spectrograms with segment boundaries which were automatically aligned using MAuS [36] with an AusE model. Outlier values were identified and hand-corrected where necessary, as were any notably large changes in formant

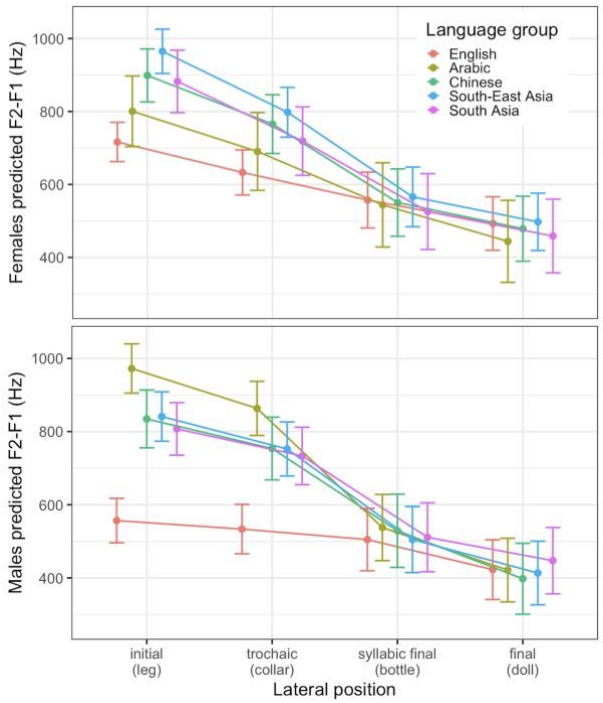

Figure 1: *Predicted midpoint /l/ F2–F1 by lateral position and language heritage group for female (top) and male (bottom) speakers.*

trajectories across the lateral that may have suggested errant formant tracks. After this, the difference between F2 and F1 (F2–F1) was calculated at the lateral midpoint.

Various /l/ darkness metrics have been used in previous studies [5, 19, 22]. Here we use raw F2–F1 (Hz) taken at the lateral midpoint, since both formants vary in the production of clear/dark /l/; this metric has been employed successfully in a range of previous studies [1, 3, 6]. The advantage of this approach is that it enables observation of how clear or dark laterals are in absolute terms [6].

We opt for using raw over normalised formant values because speakers in this corpus vary in the degree to which they exhibit short-front monophthong lowering, a change in progress in AusE [32, 37]. Today /æ/ forms the lower extremity of the vowel space for many, but not all, younger AusE speakers [32, 37]. As such, it may not be appropriate to normalise formant values given that the phonetically lowest vowel in the system varies between speakers. Since no normalisation is conducted beyond the effect of taking the difference between F2 and F1 [see 6], we analyse male and female speakers separately.

We turn briefly to vocalisation; some previous studies of AusE have opted to exclude vocalised tokens of /l/ [e.g. 19]. [38] suggests that the prevalence of vocalised /l/ varies regionally in AusE, being somewhat common in Sydney but less so than in cities like Adelaide. Vocalised /l/ is difficult to reliably distinguish from canonical dark /l/ via auditory and spectrographic evidence alone [17, 39]. We therefore have elected not to differentiate vocalised and canonical dark /l/ in this study, and include both.

2.2.2. Data analysis

We fitted linear mixed effects models to analyse lateral midpoint F2–F1 variability with the lme4 package [40]. Post-hoc analysis in the form of pairwise comparisons was conducted using the emmeans package, with Tukey corrections for *p*-values [41]. Separate models were fitted for the male and female speakers. Both modelled F2–F1 with fixed effects for language heritage group and lateral positional context and their interaction, with random intercepts included for word and participant. *P*-values for fixed effects and interactions were calculated using type III ANOVAs with the afex package [42].

3. Results

In both models, the interaction of language heritage group and /l/ positional context significantly affected F2–F1 (females: $F(12, 3143.97) = 20.43$, $p < .001$, males: $F(12, 3033.29) = 54.64$, $p < .001$). Figure 1 plots predicted variation in midpoint /l/ F2–F1 for female (top panel) and male (bottom panel) speakers, with higher F2–F1 values indicating clearer /l/s. It is apparent that the interaction affects /l/ darkness in both models: estimated F2–F1 varies between positional contexts for all language groups, but to different degrees. The subsequent sections describe results from pairwise comparisons which show significant differences between /l/ positional contexts and heritage language groups.

3.1. Female speakers

3.1.1. /l/ darkness between positional contexts—females

The top panel of figure 1 shows that generally, the female speakers in all language groups produce a positional distinction between word-initial and word-final /l/. Results from pairwise comparisons confirm these observations: all groups have significantly higher F2–F1 in word-initial /l/s (as in *leg*) than in word-final (*doll*, all $p < .0001$) or syllabic final /l/s (*bottle*, all $p < .001$). All groups also had clearer /l/s in medial trochaic contexts (e.g. *alligator*) than in word-final contexts (all $p < .007$), and all apart from the English heritage group had clearer trochaic /l/s than syllabic final /l/s as well (English $p = .331$; all others $p < .048$). Every group also had clearer initial /l/s than medial trochaic /l/s (all $p < .029$). None of the groups differed significantly in final vs. syllabic final /l/ contexts.

3.1.2. /l/ darkness between diversity groups—females

For the female speakers, /l/ darkness appears to vary between heritage language groups in different positional contexts, with the English and Arabic heritage groups producing darker /l/s in certain contexts than the other groups. Post-hoc analysis confirms this: the English heritage group had significantly darker word-initial /l/s than the Chinese ($p < .0001$), South-East Asian ($p < .0001$), or South Asian ($p = .0007$) heritage groups, and the Arabic heritage group also had significantly darker /l/s than the South-East Asian heritage group in this context ($p = .0091$). Furthermore, the English heritage group had significantly darker trochaic /l/s than the Chinese and South-East Asian heritage groups (both $p < .004$). None of the heritage language groups differed significantly from one another in word-final or syllabic final /l/ contexts.

3.2. Male speakers

3.2.1. /l/ darkness between positional contexts—males

As can be seen in the bottom panel of figure 1, the male speakers in all groups seem to produce clearer word-initial /l/s and darker word-final /l/s. Again, results from pairwise comparisons confirm this. For all groups word-initial /l/ (e.g. *leg*) had significantly higher F2–F1 than final /l/ (e.g. *doll*: all $p < .0126$). Trochaic /l/ (e.g. *alligator*) was significantly clearer

than final /l/ for all groups except the English heritage group (English $p = .0811$; all other groups $p < .0001$). The Arabic, Chinese, South-East Asian and South Asian heritage groups also showed significantly clearer initial /l/s than those in both syllabic final (all $p < .0001$) and medial trochaic contexts (all $p < .048$), but this was not true for the English heritage group for either of these contrasts; these same four groups also produced clearer trochaic /l/s than syllabic final /l/s (all groups $p < .0002$), whereas again the English heritage group did not. None of the groups differed between word-final versus syllabic final /l/ contexts.

3.2.2. /l/ darkness between diversity groups—males

As with the female speakers, there are noticeable differences in /l/ darkness between language heritage groups of male speakers, most obviously in word-initial and medial trochaic contexts. The Arabic, Chinese, South-East Asian and South Asian heritage groups all had significantly clearer /l/s than the English heritage group in initial (all $p < .0001$) and trochaic contexts (all $p < .0001$).

In addition to this, the Arabic heritage group had significantly clearer word-initial /l/s than the Chinese, South-East Asian and South-Asian heritage groups (all $p < .0027$), and clearer trochaic /l/s than the South Asian and South-East Asian groups (both $p < .0301$). As with the females, none of the male language heritage groups differed significantly from each other in their production of word-final or syllabic final /l/s.

4. Discussion

Broad patterns are observable in the results, both for female and male speakers. In general, onset /l/s were clearer than coda /l/s for all groups, regardless of gender or heritage language background. We observed that trochaic /l/s (e.g. *alligator*) were significantly clearer than word-final laterals, exhibiting characteristics more similar to onset /l/s than coda /l/s, as has been found in some previous work [6, 28]. However, we also saw that some groups had significantly clearer word-initial /l/s than medial trochaic /l/s, which may be attributed to coarticulatory factors. As discussed earlier, clearer /l/s are known to be more susceptible to coarticulatory influence from surrounding vowels than darker /l/s [3, 12, 13]; therefore the relatively darker /l/s we observed word-medially may have been realised in this manner as they experience coarticulatory influence from both preceding and following segments, whereas word-initial /l/s do not. Future research should investigate this further.

The results also make clear the extent to which language heritage may impact lateral realisation. For females, the English (and to an extent Arabic) heritage speakers produced darker word-initial and trochaic than those in the Chinese, South-East Asian and South Asian heritage groups. Among the males, the English heritage speakers also produced darker onset /l/s than the Chinese, South-East Asian and South Asian heritage group speakers, but here the Arabic heritage speakers can be characterised as producing "hyper-clear" onset /l/s, with F2–F1 values higher than all other groups. Previous work has suggested that clearer onset /l/s may be a feature inherited from heritage languages [e.g. 9, 22, 23, 24]. In many of the participants' heritage languages—including Arabic [19, 22], Punjabi [24], Hindi [43], Cantonese [44], and even common L2 varieties like Indian English [45]—/l/ is described as acoustically clear. On the other hand, the model predictions of word-initial /l/ F2–F1 for both the female and male English heritage speakers (approx. 750 Hz and 620 Hz respectively) are similar those reported in Manchester [6, 11] and Glasgow [46], where onset /l/ is described as dark. Our results therefore confirm previous descriptions of AusE /l/ as being acoustically dark in all contexts for participants with monolingual English-speaking heritage [14, 15, 20], but suggest that this characterisation is limited in the context of increased diversity in the speech community—as [19] also shows.

However, the Arabic heritage male and female speakers appear to realise initial and medial /l/s differently, with males having very clear /l/s relative to other groups of the same gender, and females somewhat darker than most. We do not directly compare male and female speakers in this analysis, and we note that the number of Arabic heritage females ($n = 5$) is quite low, but this observation complicates the idea that differences in /l/ darkness are attributable solely to heritage language transfer. One of the key findings in [19] was that Lebanese heritage speakers (both male and female) with more densely Lebanese social networks produced clearer initial /l/s than those with fewer Lebanese contacts. It may be that the difference between males and females of Arabic heritage in our sample reflects the extent to which individual speakers are integrated into their heritage language communities. More research is needed to investigate this hypothesis.

Lastly, we turn to some limitations of the current analysis and directions for future study. This study uses citation form data, so investigation of conversational /l/ productions is required. Our use of lateral F2–F1 midpoint as a metric of /l/ darkness also precludes examination of formant trajectories transitioning into and out of the lateral. A future analysis could use dynamic formant analyses to better assess the effect of coarticulation from adjacent segments on /l/ darkness.

5. Conclusion

This study reported on variation in /l/ darkness in AusE, showing that speakers produce a positional distinction between clearer initial and darker final /l/s, corroborating previous research [19, 20] and extending these analyses by incorporating /l/s elicited word-medially. Furthermore, we showed that speakers with different heritage language background varied in their production of initial and medial /l/s: speakers with a non-English language heritage generally produced clear /l/s in these contexts, whereas speakers with English-only backgrounds produced much darker onset /l/s. We have also outlined directions for future research, including closer consideration of coarticulatory factors and incorporation of dynamic analyses.

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