Regional Distribution of the /el/-/æl/ Merger in Australian English

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Background

- Australian English has long been considered regionally homogeneous but has "begun to exhibit more widespread social and regional variation than has previously been acknowledged" (Cox and Fletcher, 2017, p. 20)
- Large-scale geolinguistic studies remain few
- This research concerns **prelateral merger of /e/ and /æ/** (e.g., *celery = salary*, *Alan = Ellen)*
- Previously investigated mainly in southern Victoria/Melbourne (e.g. Diskin et al. 2017; Diskin-Holdaway et al., 2024; Loakes et al., 2017, 2024); some evidence for the merger from Queensland
- Previous studies have mostly relied on small datasets and controlled wordlist recordings
- We consider the merger in a **large, naturalistic speech dataset**:

1. Is the merger of /el/-/æl present across all states of Australia, or only in Victoria?
2. How does the merger pattern in a large-scale corpus of naturalistic speech, compared to the small samples of controlled word list data that has dominated previous research?

Materials and Methods

- Data from **CoANZSE Audio** (https://coanzse.org)
- Audio and ASR transcripts from 38,786 videos uploaded to YouTube channels of Australian local councils in 404 locations (Coats 2024a,b)
- Phone-level alignment with the **Montreal Forced Aligner** (McAuliffe et al. 2017) and its default English acoustic model and dictionary (v3.0.0)
- F1 and F2 formant values for /e/ and /æ/: Extracted at vowel midpoints using **Parselmouth-Praat** (Jadoul et al., 2018), a Python interface for **Praat** (Boersma and Weenink, 2024)
- Vowels were extracted from stressed syllables in two contexts: prelateral (/æl/ and /el/, e.g. *value*, *well*) and non-prelateral (/æC/ and /eC/, e.g. *fact*, *next*)

Table 1: Number of vowel tokens by state/territory and context

Loc.	Context	count	Loc.	Context	count
ACT	/æl/	548	SA	/æl/	10,456
	/æC/	11,308		/æC/	240,279
	/el/	1,232		/el/	22,726
	/eC/	11,917		/eC/	269,945
NSW	/æl/	20,105	TAS	/æl/	4,178
	/æC/	465,825		/æC/	89,067
	/el/	46,508		/el/	8,815
	/eC/	531,894		/eC/	94,512
NT	/æl/	85	VIC	/æl/	29,097
	/æC/	1,346		/æC/	625,318
	/el/	163		/el/	69,308
	/eC/	1,590		/eC/	683,640
QLD	/æl/	13,875	WA	/æl/	5,233
	/æC/	332,394		/æC/	133,116
	/el/	28,041		/el/	14,016
	/eC/	375,405		/eC/	155,317

- After filtering, 4,297,259 vowel tokens from 252 locations (Tab. 1)
- Quantifying the merger: **Bhattacharyya Difference**, the difference of negative logarithm of the Bhattacharyya Coefficient (Bhattacharyya 1943) for the two contexts in each location

$$Bhattacharyya\ Coef. = \int \sqrt{P(x) \cdot Q(x)}dx$$
$$Bhattacharyya\ Dist. = -\ln(BC)$$
$$\boldsymbol{Bhattacharyya\ Diff. = BDist_C - BDist_L}$$

- **For each location, how merged are vowels in non-prelateral contexts such as *fact* and *next* compared to prelateral contexts such as *value* and *well?*** (Tab. 2)

Table 2: Interpretation of Bhattacharyya Difference values

BDiff > 0	/e/ and /æ/ more different before C than before L
BDiff = 0	/e/ and /æ/ equally different before /e/ and /æ/
BDiff < 0	/e/ and /æ/ more different before L than before C

Spatial analysis

- **Moran's *I*** for global spatial autocorrelation (Moran, 1950): **Are the BDiff values spatially clustered in this dataset?**
- **Getis-Ord local G_i^*** for local spatial autocorrelation (Getis and Ord, 1992; Ord and Getis, 1995; Getis, 2010): **For each location, is it in a "hot spot" or a "cold spot"?**

Table 3: Interpretation of Moran's I and Getis-Ord Gi values*

I = 1	Values perfectly clustered
I = 0	Values randomly dispersed
I = -1	Values perfectly distributed
$G_i^* > 0$	Location is in a "hot spot"
$G_i^* < 0$	Location is in a "cold spot"

Results

- Overall, these two vowels are more distinct in non-prelateral contexts and more similar in prelateral contexts (Fig. 1)

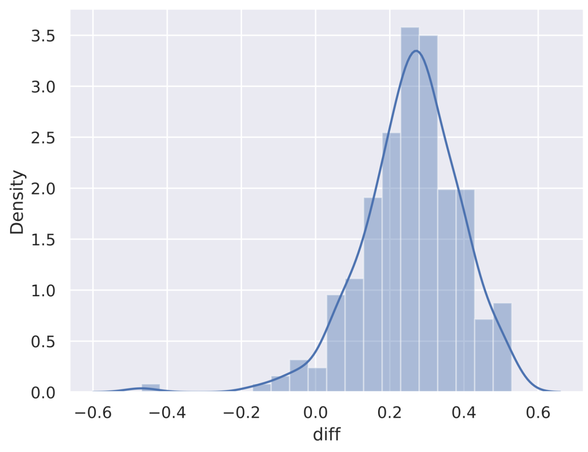

Figure 1: Bhattacharyya Difference values for 252 locations

- Trend is strongest in Victoria (Fig. 2)

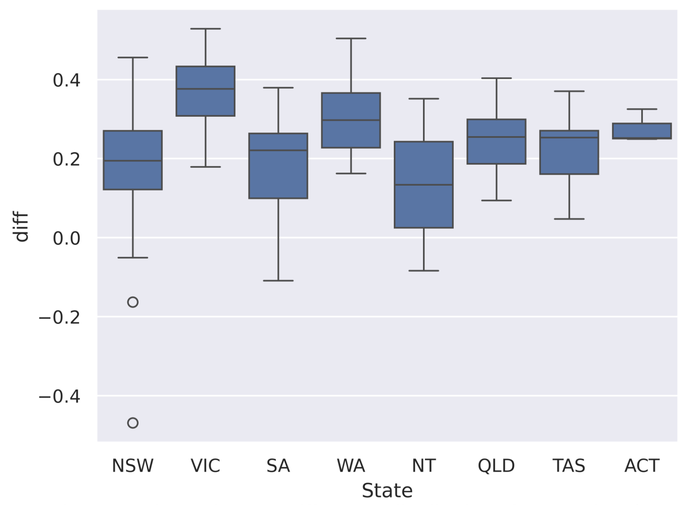

Figure 2: Bhattacharyya Difference distributions for State/Territory

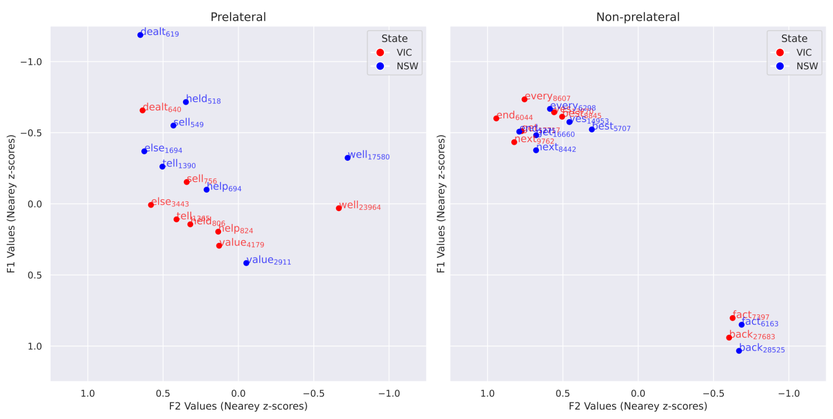

Figure 3: Mean locations of most frequent words, prelateral context (left) and non-prelateral context(right), Nearey-z-score-transformed F1/F2 values

- Mean F1/F2 values for vowels in selected common words, as realized by Victorian speakers (red) and New South Wales speakers (blue), are quite similar in non-prelateral contexts (on the right), but differ in prelateral contexts (left)

- Moran's I = 0.235, p = 0.001
- **Moderate clustering of the merger**

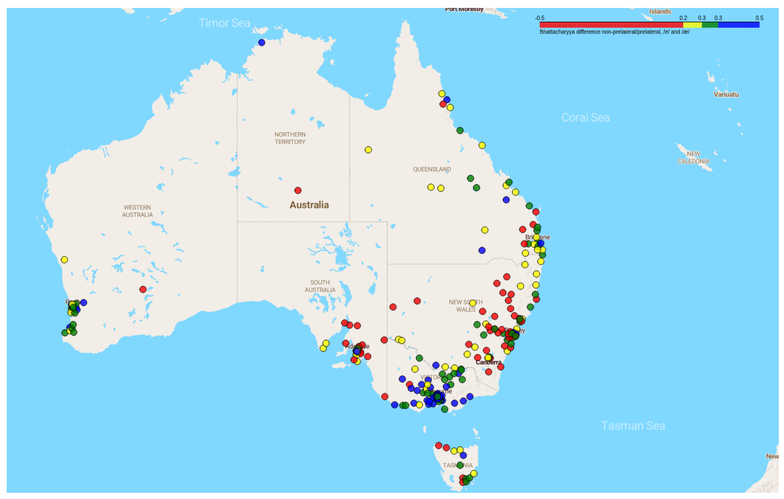

Figure 4: Bhattacharyya Difference values

- Raw BDiff values: Highest in Melbourne and Southern Victoria (Fig. 4)
- Smoothed values (spatial correlation statistic G_i^*): trend is strongly evident (Fig. 5)

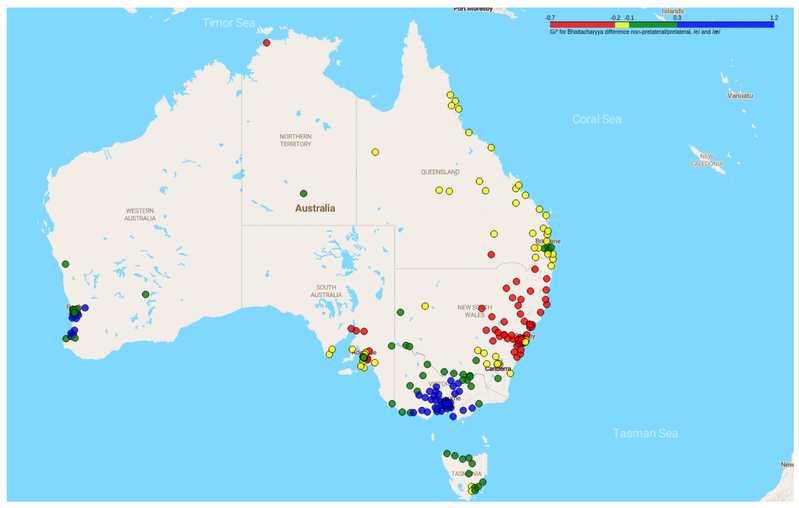

Figure 5: G_i^* values for Bhattacharyya Difference

Conclusions, caveats, and outlook

- Confirmation of previous research: Feature is strongest for speakers in Melbourne and Southern Victoria
- Values for Perth/Western Australia warrant investigation
- False positives and lack of speaker diarization may limit the generalizability of findings
- Future work: automatic annotation of demographic parameters, investigation of specific localities and discourse contexts

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