

Acoustic-articulatory dynamics of palatalisation in Scottish Gaelic sonorants

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This paper investigates the acoustic and articulatory dynamics of an unusual three-way contrast in secondary palatalisation. Contrastive secondary palatalisation is well-documented in pairs of consonants in Slavic and Goidelic, as well as many other languages (Kochetov 2002, Bennett et al. 2018). More unusual, however, is a three-way contrast in secondary palatalisation which is the subject of the current study. Our project considers the acoustic and articulatory dynamics of the reported three-way distinction in Scottish Gaelic laterals and nasals between palatalised, alveolar and velarised sonorants (Borgstrøm 1940, Ladefoged et al. 1998). A detailed acoustic and articulatory analysis of this proposed system has not been conducted before, and typologically unusual systems may be subject to rapid and widespread change in situations of language endangerment (Jones 1998).

Acoustic and ultrasound data were collected from twelve L1 Gaelic-dominant adult speakers from the Isle of Lewis. Data were recorded from a word list containing Gaelic and English lateral, nasal and rhotic consonants. Here we report on the Gaelic laterals and nasals only. We elicited word-initial and word-final tokens in three vowel contexts. Data were recorded using midsagittal ultrasound tongue imaging at ~100 Hz, with synchronised acoustic data, which resulted in ~1500 tokens. Acoustic measures of F2-F1 and F3-F2 were extracted across the sonorant-vowel interval, while splines were semi-automatically fitted to the ultrasound image tongue contour across the same interval.

Our first analysis considers formant measures and mid-sagittal tongue splines at temporal midpoint (see Figure 1 for ultrasound analysis example). Our second analysis considers the dynamics of palatalisation contrasts across the sonorant+vowel or vowel+sonorant interval. Ultrasound data were parameterised by tracking tongue displacement across three vectors positioned in the alveolar, palatal and velar regions of the ultrasound image for each speaker. We then examined the temporal unfolding of formants and tongue displacement across time using generalised additive mixed-models (GAMMs). This allows us to consider dynamic acoustics and lingual gestures in order to establish the extent and nature of phonemic contrast in the acoustic and articulatory domains (see Figure 2 for dynamic ultrasound analysis example).

Results indicate robust maintenance of the reported three-way phonemic contrast in laterals in both acoustics and in articulation. The results for nasals are more complex, but largely point towards a two-way contrast between velarised and other nasals. This is clear in the acoustic data and largely borne out in the ultrasound results. We also find clear articulatory correlates of velarisation versus palatalisation in these data. We discuss the lateral results with reference to the typology of palatalisation across the world's languages and in terms of the robust maintenance of an unusual three-way palatalisation contrast despite pressures from Gaelic's endangered status. Our discussion of the nasal consonants considers the complex acoustic nature of nasal stops, and changes to the nasal system in other Goidelic dialects.

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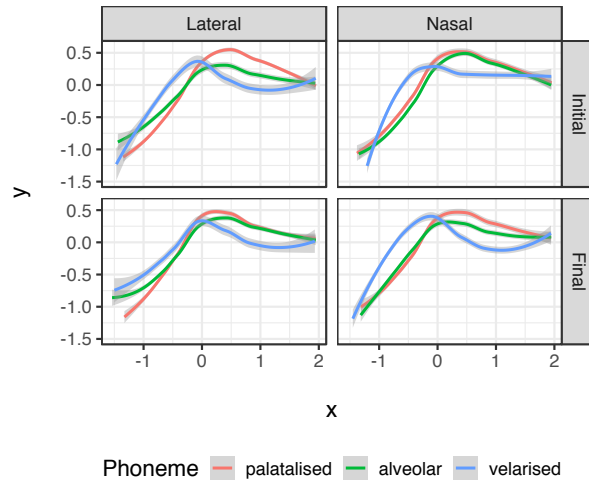


Figure 1: Lateral and nasal mid-sagittal tongue splines extracted at temporal midpoint of the sonorant produced by a female speaker. Left panels show laterals and right panels show nasals. Top panels show word-initial tokens, right panels show word-final tokens. Colour shows sonorant phoneme.

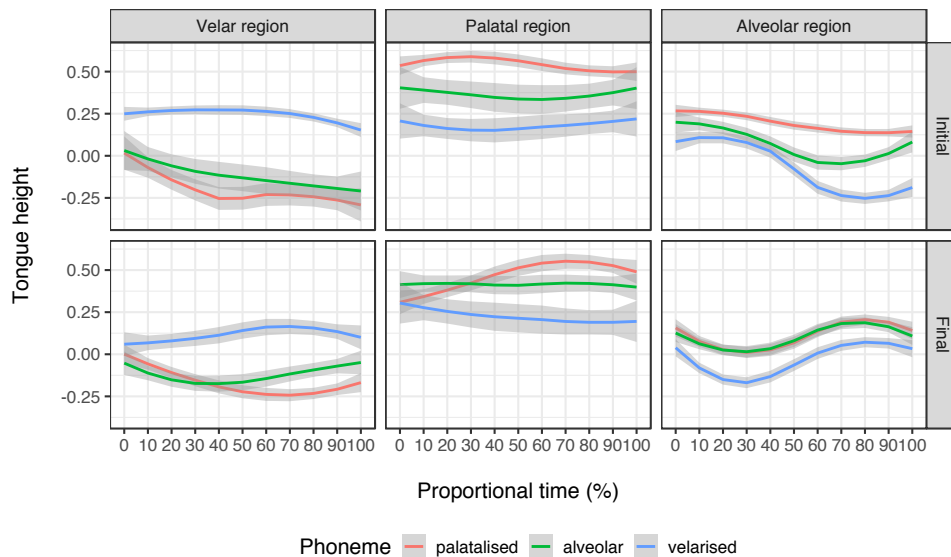


Figure 2: Tongue movement through a vector in the velar region (left panels), palatal region (centre panels) and alveolar region (right panels). Figure shows lateral+vowel for word-initial context and vowel+lateral for word-final context. Data from one female speaker shown here.