

Vowel development in typically-developing Scottish primary-school children

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As children leave their caregivers and join their peers in primary school, their linguistic variation shifts from their caregivers' patterns towards changing community norms. Whilst studies have considered sociolinguistic variation and change in infants and (pre)adolescents, much less is known about sociophonetic variability, including dialectal variation, as children negotiate their primary years (~5 to 11 years; e.g. [1, 2]). At the same time – and especially for vowels – cross-sectional, developmental speech production studies typically include primary-aged children in samples from infancy to adolescence/adulthood: their results reveal gradient shifts by age in terms of reduction of formant frequencies, vowel dispersion and variability, explained in terms of maturational changes in vocal tract size and articulatory motor control (e.g. [3]). A question arises: how do social and developmental factors underpin trajectories of vowel variation and change in primary-school children?

This study begins to tackle this question in Scottish English child speech, from 224, 5-11 year-old typically-developing, children, in three age cohorts (~5-6/7-8/9-11 years), identifying as female/male (131/93), from three central regions of Scotland (West, South, East). 11,436 tokens of /i e ɪ ε a ʌ ɔ o ʊ/ were analysed from versions of target words in a picture-naming task. 657 recordings were auto-transcribed by WhisperX, manually corrected, force aligned using a bespoke adapted model in MFA, and handchecked again [4], before extracting static mean first/second formant measures, which were trimmed [5] and normalized in *phonR()* using the Nearey2 ('logmean') method. F1 and F2 were jointly modelled in a multivariate Bayesian regression model [6] with *log duration*, *Scottish Index of Multiple Deprivation*, and *gender*, *age*, *region*, all two-way and their three-way interaction, and a by-speaker correlation term for {F1,F2} intercepts. Vowel space areas (VSA) were calculated from the model-estimated logmean F1 and F2 for each speaker using *geometry()* in R for the three peripheral vowels /i a o/, and modelled with a linear regression for *age*, *gender*, *region* plus their interactions.

Both Hz and normalized measures showed similar patterns of results, namely a significant main effect of *age*, and/or *gender*, and/or *region*, for F1 and F2, for all vowels, either as a main effect, or in interaction with each other. VSA from the three peripheral vowels /i a o/ also gives a significant *age*gender*region* interaction. If we consider the results only for age, then there is an effect of increased peripheralization of acoustic vowel quality by age, especially for /i e a o/, but this is substantially modulated by effects of gender (with more peripheral /i e a ʌ/ in boys) and region (with South Central Scottish children showing clearly different qualities for /e ɪ a o ʊ/); and in fact, increased vowel space by age is only apparent in children from East Central Scotland, and girls from the West. Rather, the results show that acoustic vowel quality and space are structured by all three factors together and by vowel. This suggests that by 5 years old, children have substantial control of structured sociophonetic vocalic variation [cf 7], and that by 7 years, some children are style-shifting to produce citation forms – increased (rather than reduced) VSA by age in both Hz and normalized measures aligns with findings of hyperarticulation of stressed vowels by age in [8]. Finally, whilst there is clearly structured variation for each vowel, there is little overt evidence in these data either for adult-like social stratification in terms of gender, or for age-graded patterns by dialect and gender, which align with trajectories of ongoing reported vowel changes for /ɔ o ʊ/ [cf. 9].

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