

## Articulation at the end stage of sound change: Derhoticisation across east Lancashire

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Our study investigates auditory realisation, acoustics, and articulation of coda rhoticity across east Lancashire. Loss of coda rhoticity in England is a long-term, ongoing sound change, which is nearing completion. Small areas of variable rhoticity still exist, however, in the dialects of east Lancashire [1]. Production of rhoticity involves multiple articulators therefore leading to complex acoustic-articulatory relationships [2]. While articulation of rhoticity loss in Lancashire has been analysed within specific areas, we now provide a *cross-community comparison*. In doing so, we analyse derhoticisation as a window into the articulatory mechanisms during sound change diffusion across communities [3], specifically *gestural reduction and gestural retiming*. We address the following questions:

1. How is rhoticity realised in two communities undergoing derhoticisation (auditory analysis, dynamic acoustics, articulation)?
2. Is articulatory derhoticisation realised through gestural reduction in magnitude or re-timing? Does this vary between communities with differing rhoticity rates?

**Methods:** Acoustic and ultrasound tongue imaging data were collected in two east Lancashire towns, Blackburn and Burnley, during public engagement events at market stalls in each town. Here, we analyse recordings of 18 adults from Blackburn, and 23 adults from Burnley. Five participants were British Asian, and 36 White British. Each participant read a list of 13 words twice, including 9 words with potential rhoticity. Our analysis includes 1057 tokens in total. **Analysis RQ1:** Data were first auditorily coded as rhotic/non-rhotic by two researchers and analysed with a mixed effects logistic regression model. We then conducted an acoustic analysis of F3–F2, an acoustic correlate of rhoticity in this variety, and analysed the vowel(+rhoticity) interval with GAMMs [4]. Finally, we fitted splines to the ultrasound images in AAA in order to visualise the tongue shapes at 80% of vowel(+rhoticity) duration. **Analysis RQ2:** Here, we focus on minimal rhoticity pairs; core/caw and pour/paw. To quantitatively analyse tongue shapes across the vowel(+rhoticity) interval, we fitted a Multivariate Functional Principal Component Analysis (MFPCA) to tongue splines [5] at 11 time-normalised points for each token. The scores from the first four FPCs were analysed further. We fitted GAMMs to the FPC trajectories and test for differences in the production of minimal pairs within each dialect. FPC scores were used to reconstruct the tongue shapes and ascertain that FPC1 corresponds to tongue tip movement, FPC2 to tongue height, FPC3 to tongue fronting, and FPC4 to tongue root.

**Results RQ1:** Our auditory analysis indicates more rhoticity in Blackburn than Burnley, and no significant differences for age or gender. British-Indian participants produced trilled rhotics, while British-Pakistani and British-Bangladeshi participants were non-rhotic. Acoustic analysis comparing Blackburn and Burnley indicates significant differences in F3–F2 trajectory height in three vowel contexts, and significant difference in trajectory shape in START vowels. Auditorily rhotic speakers produced different tongue shapes for core/pour vs. caw/paw, mainly with tip-up tongue shapes.

**Results RQ2:** There are dialectal differences in the results for FPC3 (tongue fronting) and FPC4 (tongue root). Specifically, Burnley speakers do not significantly differentiate FPC3 trajectory shape, nor FPC4 shape or height. This indicates that there are dialectal differences for magnitude of tongue fronting gesture, and both timing and magnitude of tongue root gestures in the rhoticity contrast.

**Discussion:** Our analysis indicates substantial production of rhoticity in Blackburn, but less in Burnley, where the sound change is nearing completion. We found community-level differences in the articulation of derhoticising variants, corresponding to perceived differences in amount of rhoticity. Our findings are discussed in terms of the role of articulation in the diffusion of sound change and in particular the roles of gestural reduction and retiming.

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