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### Changes in Scottish English rhoticity

Scottish English is often cited as a rhotic dialect of English. However, in the late 1970s and early 80s, researchers started to notice that postvocalic /r/ was in attrition in working-class varieties of urban Scottish English; notably in the two most populous cities *Glasgow* (Macafee 1983), (Stuart-Smith 2003) and *Edinburgh* (Romaine, 1978), (Speitel and Johnston, 1983), (Johnston, 1997).

### Qualitative changes

The r-less and derhotic variants were apparently the result of a dialect-internal vernacular sound change and not due to external Anglo-English influence. Two phenomena were noted:

- 1) Apparent loss of /r/ after vocalic breaking associated with high and high-mid vowels: [biA] "beer", [ðeA] "there", [pʰuA] "poor" and [moA] "more"
- 2) Apparent loss of /r/ after low vowels with pharyngealisation of the prerhotic vowel: [fɔʔ] "for", [kʰaʔ] "car", [fAʔ] "fur".

### Using ultrasound to look at derhoticisation

Derhoticisation is a process that is not easily studied from an auditory or acoustic perspective only. It is well known that /r/ is acoustically complex: different lingual gestures can produce similar acoustic outputs. (See Delattre and Freeman's 1968 cineradiographic study of bunched and tip-up American /r/ and more recently Guenther et al. 1999, and Alwan and Narayanan (1996), using EPG and MRI.)

Articulatory information is clearly required if we are to understand the phonetic and social processes involved in Scottish derhoticisation. The relatively young phonetic technique of ultrasound tongue imaging (UTI) seemed very suitable as a technique.

### The ECB08 UTI corpus: spontaneous discourse and experimental word list speech



Figure 1: Recording locations of the 2008 Eastern Central Belt Scottish UTI corpus (ECB08)

15 informants aged 12-13

**Livingston**  
4 WC males  
4 WC females

**Edinburgh**  
3 MC males  
4 MC females

### The effect of environment

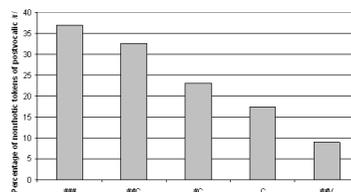


Figure 2: Level of rhoticity, showing the effect of phonological environment. Spontaneous speech data from 14 Livingston schoolboys, n = 2567

Figure 2 is based on our preliminary Livingston corpus "WL07" (Lawson, Stuart-Smith and Scobbie, in press). Derhoticised tokens were found most in "prepausal" environments. This confirms previous research by Romaine (1979: 45), Speitel and Johnson (1983: 28) and Stuart-Smith (2003), who flagged up what they variously called the "utterance-final", "level-stress" or "prepausal" environment as being conducive to weakening of rhoticity in /r/. Derhoticisation was less common than expected, and mainly occurred in weak syllables.

### The covert delayed tip-raising gesture

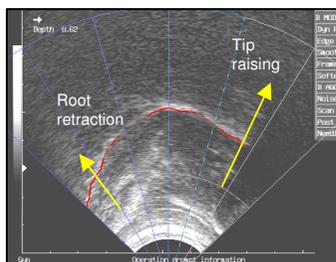


Figure 3: UTI frame with the tongue surface marked out in red, thickness indicating confidence from automatic fitting. Kinematic behaviour of parts of the curve are exported and analysed using Articulate Assistant Advanced.

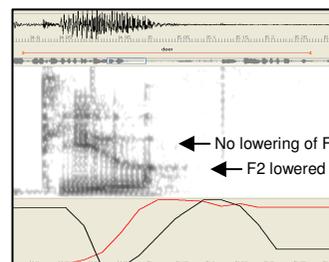


Figure 4: A spectrogram and waveform of "deer" in utterance-final position from spontaneous WC male speech from ECB08. Tongue tip raising (black) follows tongue root retraction (red) and phonation offsets, explaining the lack of rhoticity.

ECB08 confirms the previously reported discovery (Scobbie, Stuart-Smith and Sebrechts 2006) that *derhoticised* prepausal tokens may have a covert tongue-tip gesture (Figures 3, 4). ECB08 (in two WC speakers) further reveals that this can affect /r/ in diphthongs and in some clusters: *hut* and *hurt* may be homophonous. In low back *fir*, *hurt*, *car* etc. the post-alveolar gesture has a negligible acoustic effect, because it occurs when source energy is weak or absent, i.e. in the voicelessness arising from a glottal(ised) allophone of /t/, or from the utterance-final position.

Especially when following mid or high vowels, the root retraction gesture of /r/ gives rise to a clear acoustic difference between many lexemes contrasting only in the presence/absence of that /r/ (Figures 3, 4). Diphthongisation and breaking leads to the conclusion for many listeners that "r" is still present. An audible post-alveolar constriction may also remain, occurring before voicing has entirely ceased, or during breathy glottal energy in prepausal contexts. Finally, vowel duration may cue /r/ in some contexts, for some vowels.

Previous work by Sproat and Fujimura (1993), Gick et al. (2003, 2006) and Byrd and Saltzman (2003) suggests that such root-tip gestural dissociation may be due to gesture lag in lengthened syllables that occur before major boundaries. But such articulatory factors interact with segmental, social and perceptual ones: derhoticisation is clearly socially stratified.

*Speakers intend to sound derhotic yet in suitable contexts they still articulate rhotic-like postalveolar gestures.*

### Future work

•Does a typical rhotic Scot use retroflexion? MC Scottish postvocalic /r/ is usually described, from an auditory perspective, as "retroflex". However, initial analysis of the MC informants' tongue movements suggests that postvocalic /r/ might often have a bunched tongue configuration typical of American speech. Such differences are reported to have no acoustic consequences (Guenther et al 1999) so should not be socially stratified.

•What conditioned variation is there (cf. Mielke et al. in press)? We are currently quantifying the range of different tongue shapes and intergestural timing relationships in onset, prepausal singleton /r/ and prepausal clusters. As well as examining the acoustic qualities. Our main focus is on the low back vowels like /ar/, which can be monophthongal.

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