# A SOCIOPHONETIC INVESTIGATION OF POSTVOCALIC /r/ IN GLASWEGIAN ADOLESCENTS

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## ABSTRACT

This paper presents an auditory and acoustic study of postvocalic /r/ in 12 working-class Glaswegian male speakers, young and old. The results support the view that a process of derhoticisation is underway in Scottish English, but in such a way that the contrast between words with and without /r/ is still generally maintained, albeit differently for individual speakers.

**Keywords:** sociophonetics; language change; rhotic; accents of English; Scottish English

## 1. INTRODUCTION

Scottish English is often cited as a typical example of a rhotic accent of English, i.e. one in which postvocalic /r/ in words such as *car* is articulated [7]. The realization of /r/ postvocalically in Scottish English, as in other positions, is variable: trills are rare or stereotypical [2]; alveolar taps and post-alveolar and retroflex approximants are more common [1].

But sociolinguistic research suggests that postvocalic /r/ in Scottish English is changing. Over the past 30 years working-class speakers in Edinburgh and Glasgow have been heard to use either 'plain' vowels, i.e. vowels without audible secondary articulation, similar to vowels in syllables without /r/, or variants which are difficult to classify, and which may be regarded either as vowels accompanied by audible pharyngealization and/or uvularization, or very weak uvular/ pharyngeal approximants, transcribed here with [ˤ] [e.g. 1, 6]. The data point to a process of derhoticisation, during which primary alveolar contact or approximation is first being substantially reduced, while secondary pharyngealization is maintained, until that too is gradually reduced.

The most widely-recognized acoustic characteristic of the alveolar and retroflex approximant variants of /r/ (cf [5] for US English) is lowering of the third formant. Other articulatory variants are reported with different acoustic properties [2], for example, uvular /r/ typically shows a raised F3. There are no acoustic studies of Scottish derhoticised variants, but Plug and Ogden's [3] auditory and acoustic study of variable 'deletion' of postvocalic /r/ in Dutch shows similarities with Scottish English. Their parametric analysis of aspects of the rhyme for words with and without /r/ showed that syllables with /r/ remained distinct from those without through longer vowel durations, and differing vocalic and consonantal quality.

This paper presents an auditory and acoustic analysis of postvocalic /r/ in Glasgow English, and asks the following research questions: What is the realization of postvocalic /r/ in Glaswegian? What are the characteristics of postvocalic /r/ in flux?

## 2. METHODOLOGY

The data for the paper are taken from digital recordings made in 2003 for a sociolinguistic study of Glaswegian speech. We present results from 12 male working-class informants, in four age groups, **1** (10-11 years), **2** (12-13 years), **3** (14-15 years), **4 (**40-60 years), who were recorded reading a wordlist of over 200 words once, using wide-frequency clip-on microphones, onto a Sony TCD-D8 DAT recorder, in a quiet room.

We focus on postvocalic /r/ following /a/, before a consonant, or prepausally, in the following subset of words: *hat/heart*, *ban/barn*, *fan/farm*, *cat*, *car*, *far*, *card*. We note that the location of the words in a wordlist means that prepausal is also utterance final.

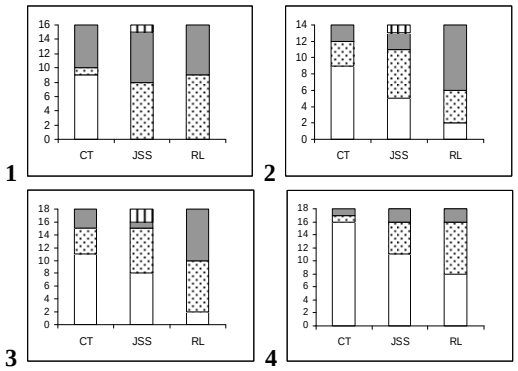
The recordings were digitized into a CSL, at 44,100Hz/16 bit. Our analysis was informed by that of Plug and Ogden [3], who worked on the assumption that phonetically postvocalic /r/ is a property of the entire rhyme, and thus analysis of /r/ entails considering features of the vocalic portion of the syllable as a whole. This seemed a useful approach for Glaswegian where it is increasingly difficult to identify /r/ as a segment.

Narrow auditory transcription was carried out by three transcribers from listening repeatedly to single word files presented through Praat. The acoustic analysis was preceded by labelling the waveform for onset and offset of the vocalic portion for words with and without phonological /r/. In some prepausal tokens it was not always easy to identify vocalic offset from the waveform alone, and the visible offset of formants on the spectrogram was used as an additional criterion. Three sets of measures were taken for adolescent speech, where derhoticisation was most evident: *duration of vocalic portion*: vowel offset minus vowel onset; *vowel quality at midpoint*: first three formants at the temporal midpoint of the duration; *vowel quality at end*: first three formants at the 5 glottal pulses up to and including the end of the vocalic portion. All formant measures were taken by hand from LPC spectra in conjunction with DFT spectra and wideband spectrograms. Tokens for which it was difficult to achieve reliable measures were excluded. Statistical analysis used unpaired t-tests.

## 2. AUDITORY ANALYSIS

Figure 1 collapses the transcription results into larger categories. [r] includes articulated realizations of /r/ ([ɻ], [ɹ], [ɾ], and [r]), [r/V] has the auditorily difficult group of pharyngealized and/or uvularized vowels, [V] contains 'plain' vowels, and [Vh], are vowels followed by [h]/[ħ].

**Figure 1:** Auditory results for postvocalic /r/ in 12 male working-class speakers for group **1** (top left), **2** (top right), **3** (bottom left) and **4** (bottom right), by 3 transcribers, CT (left bar), JSS (middle bar), RL (right bar). Total counts of variants for words with /r/ run from bottom, white [r], through dotted [r/V], grey [V] to vertical striped [Vh] at the top.




Two findings are clear. Each transcriber is different from each other, but relatively consistent within themselves (cf [3]). The result reminds us that even narrow transcription requires the fitting of chunks of an auditory continuum into discrete categories, and the boundaries of a 'fuzzy' category, such as that covered by [r/V], may be placed differently by different transcribers. Second, we see the most use of vocalized variants in the youngest speakers, but much less in adults. This, taken together with results from similar speakers in the same area in 1997 [6], suggests that these data may indeed be interpreted as language change in progress.

Results of the auditory analysis for the individual speakers as transcribed by the 'middle' transcriber (JSS), who falls between the most conservative, hearing least vocalization, and the most progressive, hearing the most, are given in Table 1. While the general pattern, of articulated /r/ occurring more in older speakers, and vocalization more in younger speakers, is maintained, here we also see the degree of individual variation. For example, all group 1 boys are heard as derhoticised, but with differing distribution of variants. In group 2, only 2m4 is heard as having no articulated /r/ variants. Only two speakers sound fully rhotic, 3m1 and 4m2.

**Table 1:** Realization of postvocalic /r/ in 12 male working-class Glaswegian speakers as transcribed by transcriber JSS. **[ɾ]** includes devoiced taps; **[ə]** includes a range of low mid vowels varying in retraction.

| | **[r]** | **[ɾ]** | **[ɻ]** | **[aˤ]** | **[aħ]** | **[ə]** | *n* |
|---|---|---|---|---|---|---|---|
| 1m1 | 0 | 0 | 0 | 2 | 0 | 3 | *5* |
| 1m2 | 0 | 0 | 0 | 2 | 1 | 2 | *5* |
| 1m3 | 0 | 0 | 0 | 4 | 0 | 2 | *6* |
| 2m1 | 0 | 1 | 1 | 3 | 0 | 0 | *5* |
| 2m3 | 0 | 2 | 1 | 1 | 0 | 2 | *6* |
| 2m4 | 0 | 0 | 0 | 2 | 1 | 0 | *3* |
| 3m1 | 0 | 1 | 4 | 0 | 0 | 0 | *5* |
| 3m2 | 0 | 2 | 0 | 3 | 0 | 1 | *6* |
| 3m3 | 0 | 0 | 0 | 3 | 2 | 1 | *6* |
| 4m1 | 0 | 1 | 0 | 4 | 0 | 1 | *6* |
| 4m2 | 1 | 2 | 3 | 0 | 0 | 0 | *6* |
| 4m3 | 0 | 1 | 3 | 1 | 0 | 1 | *6* |

## 3. ACOUSTIC ANALYSIS

### 3.1. Qualitative analysis

The acoustic analysis began with visual inspection of wideband spectrograms, which confirmed the presence of the lone trill, taps, and some weak approximants. Figure 2 shows an instance of a pharyngealized/uvularized vowel: note the slight rise and weakened amplitude of F3 (indicated with

arrow) with a slight drop and discontinuity in F1 directly preceding the stop closure.

**Figure 2:** 2m1 saying *card*, [kaˤd].

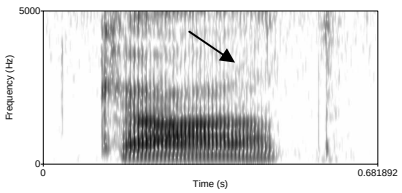



Figure 3 shows a vowel variant, with no audible secondary articulation, and no apparent shift in formant frequencies or amplitudes.

**Figure 3:** 3m2 saying *heart*, [haʔ].

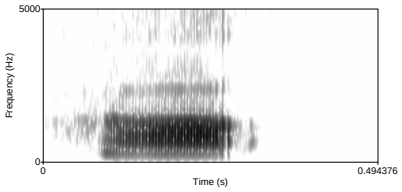
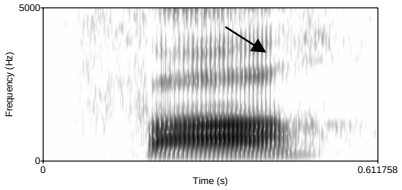



Figure 4 shows a case of vowel followed by weak devoiced voiceless pharyngeal fricative, with rising F3 losing energy shortly before the lower formants, followed by weak, scattered energy. It is unclear whether this kind of variant may be an artifact of prepausal being utterance final position.

**Figure 4:** 3m3 saying *far*, [faħ].




The qualitative analysis pointed to adolescent speakers as particularly interesting, and acoustic measures were subsequently taken from them.

### 3.2. Duration of vocalic portion

In terms of duration (Table 2), the vocalic portion of words with /r/ is longer than those without /r/ ($t(78) = -2.98$, $p = .004$). This cannot be only due to articulated /r/ lengthening, as the same pattern is found in group 1, where no articulated /r/ variants were heard. But there is also individual variation: speaker 3m1, heard as the only fully rhotic adolescent speaker, has the largest difference. The smallest differences are found in two speakers heard with only vocalized variants, although 3m2 (with the smallest difference), is heard as partly rhotic.

**Table 2:** Average durations (ms) for words with and without /r/, with proportional difference for 9 adolescent male Glaswegians.

| | **no /r/ (*hat*)** | **/r/ (*heart*)** | **Diff duration %** | *n* |
|---|---|---|---|---|
| 1m1 | 241 | 293 | 22 | *9* |
| 1m2 | 194 | 229 | 18 | *9* |
| 1m3 | 180 | 211 | 17 | *10* |
| 2m1 | 205 | 226 | 10 | *9* |
| 2m3 | 180 | 203 | 13 | *10* |
| 2m4 | 182 | 189 | 4 | *7* |
| 3m1 | 179 | 244 | 36 | *10* |
| 3m2 | 214 | 218 | 1 | *10* |
| 3m3 | 196 | 205 | 5 | *10* |

### 3.3. Vowel quality (midpoint)

While F1 tends to be lower, F2 is significantly lower in words with /r/ ($t(53) = 8.55$, $p = 000$), indicating that these words show more retracted vowels, whether or not apical /r/ is audible (Table 3). But again there are individual differences. Rhotic 3m1 has the greatest difference between non-/r/ and /r/ words, while 3m2, 3m3, and even 2m4, who showed little difference in durations, do seem to separate the forms in terms of vowel quality, even though to different degrees.

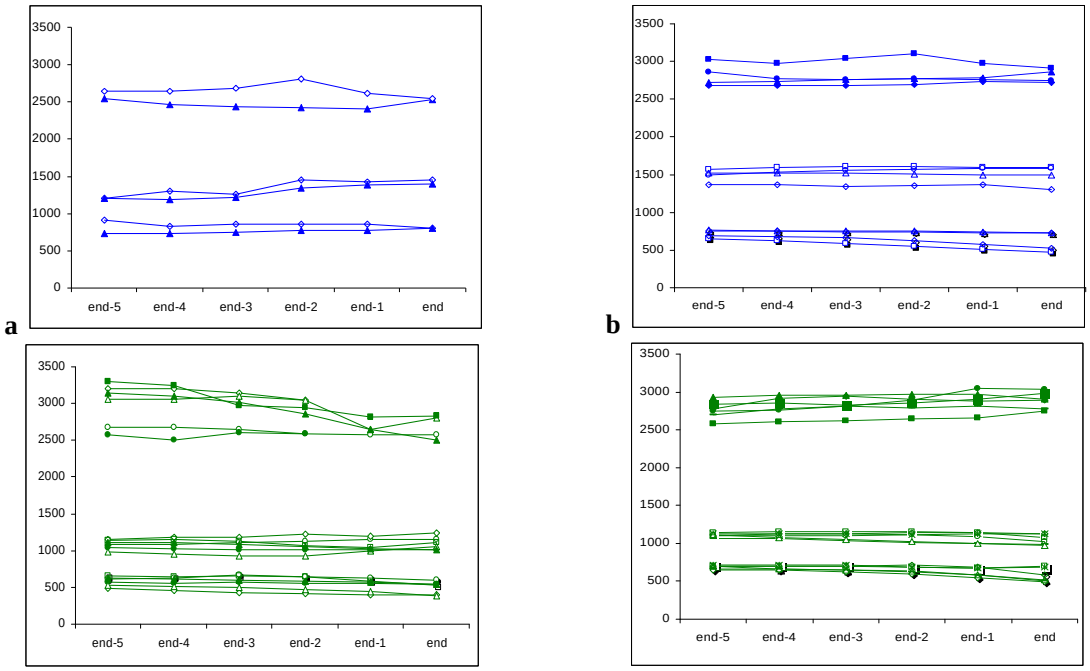
**Table 3**: Average frequencies (Hz) for F1 and F2 for words with and without /r/, and proportional difference in F2, for 9 Glaswegian adolescent males. Tokens difficult to measure are excluded.

| | **no /r/** | | **/r/** | | | |
|---|---|---|---|---|---|---|
| | **F1** | **F2** | **F1** | **F2** | **Diff F2 %** | *n* |
| 1m1 | 673 | 1331 | 636 | 1038 | 22 | *9* |
| 1m2 | 1030 | 1671 | 934 | 1321 | 21 | *9* |
| 1m3 | 736 | 1493 | 726 | 1305 | 13 | *8* |
| 2m1 | 818 | 1427 | 741 | 1299 | 9 | *9* |
| 2m3 | 686 | 1353 | 722 | 1163 | 14 | *9* |
| 2m4 | 569 | 1343 | 559 | 1219 | 9 | *7* |
| 3m1 | 714 | 1639 | 596 | 1054 | 36 | *9* |
| 3m2 | 718 | 1392 | 695 | 1178 | 15 | *9* |
| 3m3 | 734 | 1383 | 698 | 1120 | 19 | *9* |

**Table 4**: Average frequencies (Hz) for F3 for words with and without /r/, and proportional difference, for the same speakers. Tokens difficult to measure are excluded.

| | **no /r/** | **/r/** | **Diff F3 %** | *n* |
|---|---|---|---|---|
| 1m1 | 2604 | 2556 | 2 | 4 |
| 1m2 | 3392 | 3351 | 1 | 7 |
| 1m3 | 3316 | 3170 | 4 | 7 |
| 2m1 | 2533 | 2390 | 6 | 9 |
| 2m3 | 3067 | 3342 | -9 | 5 |
| 2m4 | 3529 | 3488 | 1 | 7 |
| 3m1 | 2591 | 2867 | -11 | 9 |
| 3m2 | 2257 | 2298 | -2 | 9 |
| 3m3 | 2748 | 2631 | 4 | 9 |

**Figure 5:** Formant tracks taken from the last 5 pulses of vocalic portion for each word from: **a)** 3m1, for words without /r/ (upper: *cat, hat*), and words with /r/ (lower: *barn, car, card, far, farm, heart*); **b)** 3m3, for words without /r/ (upper: *ban, cat, fan, hat*), and with /r/ (lower: *barn, car, card, far, farm, heart*).




F3 values tend to be quite high, and speakers are variable, with little proportional difference in words with and without /r/ (see Table 4); 3m1 shows the most difference. These results appear to be in contrast to those of [3].

### 3.4. Vowel quality (formant tracks)

Sample formant tracks overlaid for all words with and without /r/ from the end of the vocalic portion for two contrasting group 3 speakers are shown in Figure 5. We have noted throughout that 3m1 (left: a) was heard as rhotic, and shows most difference in all measures. His formant tracks are also clearly different. 3m3 (right: b), on the other hand, who was heard as derhoticised shows a high, flat rising F3 in his words with /r/, possibly reflecting uvularization.

## 4. SUMMARY

This study indicates a complex process of change in postvocalic /r/ in Glaswegian. Auditory analysis shows a range of possible realizations (as [1]). Acoustic analysis shows few straightforward links with auditory findings. Syllables with /r/, even with no audible apical articulation, tend to be longer, and show more retracted vowel qualities, though individual speakers may vary in the co-occurrence, and distribution, of such features. Thus the results point to derhoticisation in progress, but as in Dutch, the outcome is usually still distinct from words without /r/. Explaining this process will need recourse to articulation [4].

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