NEW LARYNGEAL ALLOPHONY IN MANCHESTER ENGLISH

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ABSTRACT

The study focuses on the relationship between pre-aspiration and glottalisation in Manchester English. Analyses of five speakers aged 20-22 years indicate there is a prosodically conditioned complementary distribution: pre-aspiration is found word-medially (*batter* [paʰtʰə]), while glottalisation occurs word-finally (*bat* [paˀt]) in plosive contexts. In fricative contexts (e.g. *mass*), analysed for the word-final condition only, pre-aspiration is found obligatorily, and, if glottalisation occurs, it thus always co-occurs with pre-aspiration. The data have also shown lack of cues to the oral gesture in the acoustic signal for a number of plosives (glottal replacement/glottalling). This has been found for the fricatives as well, but very infrequently. The results furthermore suggest that unless glottal replacement and glottal reinforcement are treated as manifestations of a single property at some level of representation, the relationship between glottalisation and pre-aspiration may be obscured, and analyses of glottalisation in accents of British English should therefore not be limited solely to glottal replacement ('glottalling').

Keywords: Pre-aspiration, glottalisation, allophony, Manchester English.

1. INTRODUCTION

With an increasing number of reports of pre-aspiration in British English [1, 3-8, 11, 17, 19] and numerous reports of glottalisation [3-5, 9-10, 15-18], the present study aimed to answer the following questions:

- Is there pre-aspiration in Manchester English?
- If so, what is the relationship between pre-aspiration and glottalisation?

In particular, we were interested in whether the two phenomena are mutually exclusive or co-occurring in the same lexical tokens. Furthermore, we wanted to know what place glottal replacement ('glottalling') has in the overall picture.

2. METHODOLOGY

2.1. Speakers and data

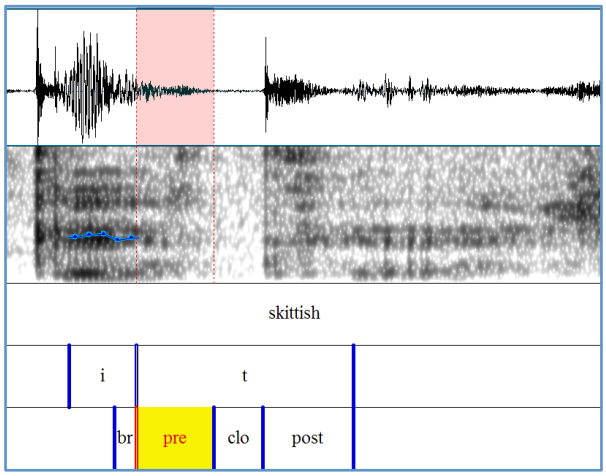
This study is based on 3 female and 2 male speakers of 20-22 years. They grew up in Manchester, as did their parents. Two word-lists were used: a shorter one for the first analyses and a longer one for later additional analyses. The items recorded were monosyllabic and disyllabic words with a word-final and word-medial plosive respectively (e.g. *luck*, *lucky*). The words combined /p/, /t/, and /k/ with /a/, /ɪ/, /ɒ/, and /ʊ/ (e.g. *pip*, *pit*, *pick*; *muppet*, *cutting*, *lucky*). Monosyllabic items with a word-final fricative (/f/, /θ/, /s/, /ʃ/) were also included, with the same vowels used in the plosive environment (e.g. *if*, *kith*, *kiss*, *dish*). All the vowel+obstruent sequences occurred in stressed syllables. The target word was always embedded in a carrier sentence *That's the word X*. This yielded 305 plosive tokens and 105 fricative tokens in total.

Three speakers were recorded in the sound attenuated room of the Phonetics Lab at the University of Manchester using the H4 Zoom Handy recorder in conjunction with C520 AKG attachable microphone. For these the data were sampled at 44.1 kHz. Two speakers were recorded with Logitech USB Desktop Microphone in the same environment, and these recordings were similarly sampled at 44.1 kHz. The analyses were done using Praat [2] and R Studio [12].

2.2. Identifying pre-aspiration

Pre-aspiration was identified as a period of voiceless friction in vowel-obstruent sequences. Breathiness was also annotated, but it was distinguished from voiceless pre-aspiration on the basis of the presence of voicing. The segmentation of each is shown in Figure 1. As visible from Figure 1, pre-aspiration also occurs in unstressed syllables in the data.

Figure 1: Pre-aspiration and breathiness.



2.3. Identifying glottalisation

Glottalisation was identified as an irregularity in the glottal pulses of the vowel. This could affect a single pulse (Figure 2) or more (Figure 3).

Figure 2: Irregular glottal pulse.

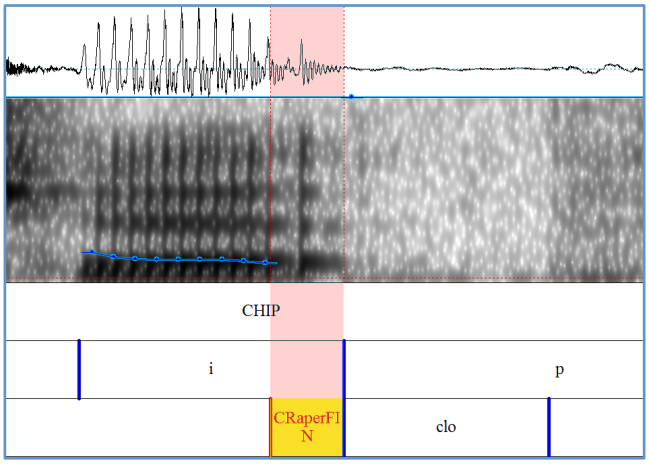
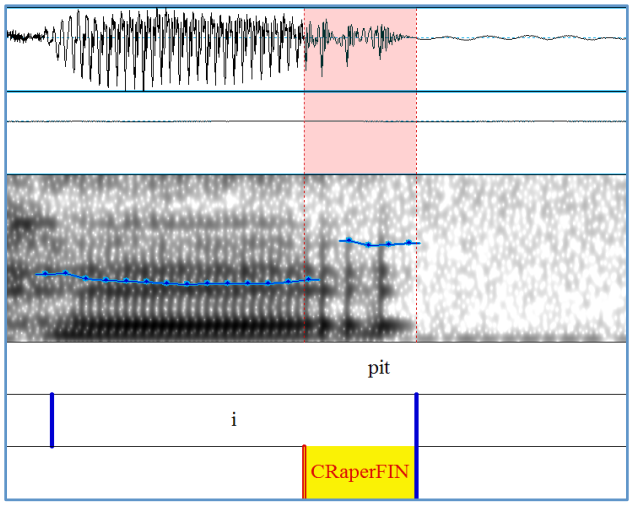
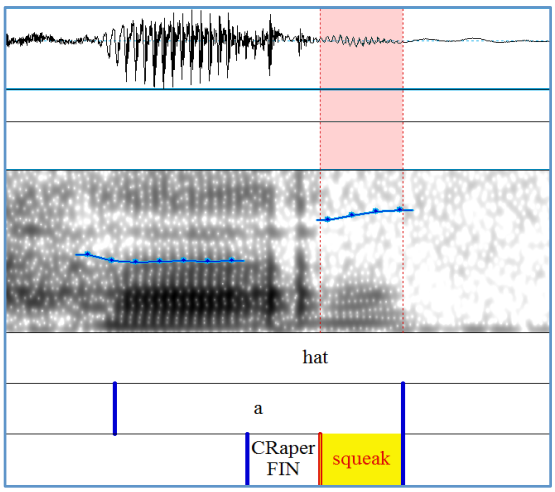


Figure 3: Irregular glottal pulses.



Periodic creak was also counted as a type of glottalisation, and it was identified based on dips in f_0. Finally, glottal squeaks [13] were considered a type of glottalisation as well (Figure 4). With one exception squeaks always co-occurred with other glottalisation.

Figure 4: Glottal squeak.



Glottalisation was labelled irrespective of the position within the vowel (initial; medial; final; spread throughout the vowel; at multiple non-contingent places within the vowel – e.g. in the middle and at the end with an interval of modal phonation between the two glottalised intervals), but this aspect was taken into consideration in the analyses.

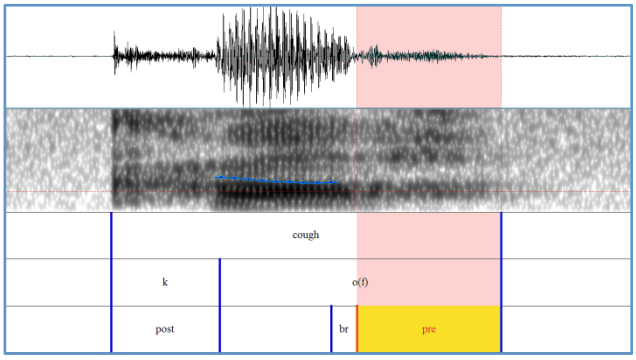
2.4. Identifying glottal replacement

Glottal replacement of the oral gesture, or glottalling [e.g. 17], was also annotated, as shown in Figure 5, whenever cues to the supraglottal gesture of the plosive or the fricative were entirely absent from the acoustic signal.

This was done when no release of the plosive could be identified. Post-aspirated, unaspirated, spirantised, and semi-spirantised releases (semi-fricative realisations [14]) were all considered as cues to an oral gesture. A fricative realised by pre-aspiration / glottal friction, rather than oral (as well as glottal) friction, was identified mainly on the basis of the spectrogram. Pure glottal friction is spectrally different from the oral friction of /f/, /θ/, /s/, or /ʃ/. It is most easily distinguishable from /s/ and /ʃ/, which show high energy in higher frequencies in the spectrogram, and the amplitude of the sound wave is also high for /s/ and /ʃ/ in comparison to /h/. /f/ and /θ/ have relatively low energy across frequencies. In comparison, spectrograms of /h/ typically exhibit relatively

higher energy at a number of frequencies. Glottal replacement of an oral fricative gesture is shown in Figure 5.

Figure 5: Glottal replacement.



3. RESULTS

This section consists of two parts. The first deals with the conditioning of pre-aspiration, breathiness, and glottalisation (subsuming glottal reinforcement and glottal replacement). The second part provides further analyses of glottal replacement. All these phenomena were analysed as categorical dependent variables (with two levels: 'present' vs 'absent'). The plosive and the fricative contexts were analysed separately as it became clear during the segmentation process that they behave fairly differently and different models had to be used: Fit Bayesian Models for the plosive context and Mixed Effects Models for the fricative context. The dependent variables were however treated in the same way. The fixed effects consisted of 'vowel phoneme', 'place of articulation', and 'syllable' ('1': word-final *luck* vs '2': word-medial *lucky*). Forward reference coding was applied to the place of articulation (/p/ vs /t/, /t/ vs /k/; /f/ vs /θ/, /θ/ vs /s/, /s/ vs /ʃ/) as well as vowel phoneme (/a/ vs /ɪ/, /ɪ/ vs /ɒ/, /ɒ/ vs /ʊ/). 'Syllable' was coded as a factor variable.

3.1. Conditioning of pre-aspiration and glottalisation

In the plosive context, a Fit Bayesian Model had to be employed because pre-aspiration and breathiness turned out to occur only in disyllables and glottalisation prevalently in monosyllables, resulting in quasi-complete separation. For a similar reason, only 'word' (and not 'subject') was defined as a random effect. The only significant predictor of pre-aspiration is the position within the word ($p < 0.0001$): the preceding vowel phoneme or the place of articulation have no effect. The same results were found for glottalisation, which is conditioned only by the position within the word ($p < 0.0001$). Thus, a clear pattern emerges: pre-aspiration occurs only word-medially ([lʊ^{h}k^{h}ɪ]), in 92% of the tokens, and glottalisation word-finally ([lʊ^{ʔ}k^{h}]), in 98% of the tokens. Word-medially, glottalisation occurs in 18% of the cases. This pattern is illustrated in Figures 6 and 7.

Figure 6: Presence of pre-aspiration and position within word.

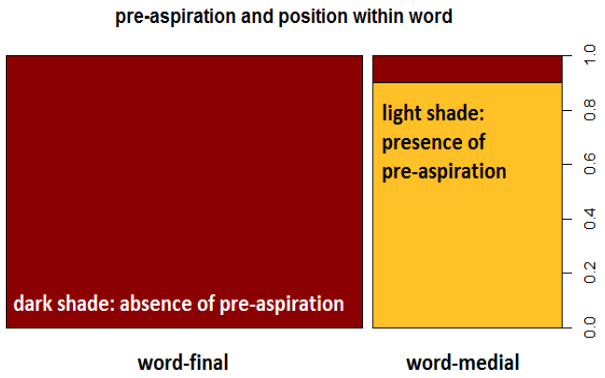
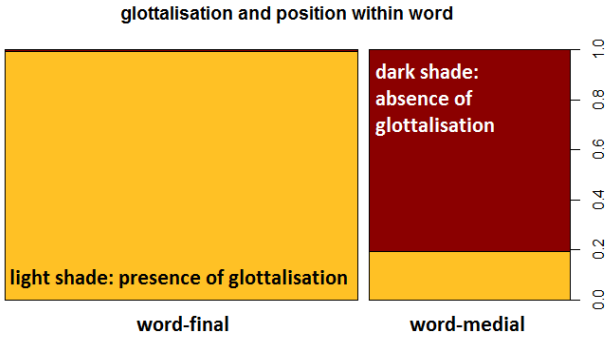


Figure 7: Presence of glottalisation and position within word.



The two phenomena therefore only ever co-occur word-medially. Most of these co-occurrences are found in one speaker (9 cases) and the remaining ones in another speaker (3 cases). 11 of these 12 cases contain glottalisation which is not vowel final, but vowel initial, medial, or spread throughout the entire vowel. These cases represent the vast majority of glottalisation found elsewhere than vowel-finally, which suggests that only vowel final glottalisation is phonologically relevant for the analyses of glottalisation in the variety.

Breathiness was similarly conditioned by position within the word, being associated with word-medial position ($p < 0.0001$), in which it occurred in 80% of the cases. It was never found in the word-final position.

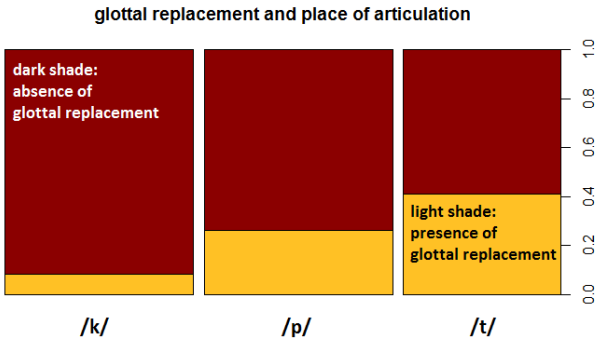
In the fricative context, Mixed Effects Models were used with 'word' and 'subject' as random effects. Pre-aspiration is obligatory for all five speakers with 92% of the items exhibiting pre-aspiration, 98% pre-aspiration and/or breathiness. 41% of the fricative data show glottalisation as well. The pre-fricative glottalisation co-occurs with pre-aspiration, and its position with respect to the vowel is more varied than in the plosive context, presumably because the phonologisation of glottalisation in the fricative context is relatively less advanced. For pre-aspiration found with fricatives, the vowel phoneme or the place of articulation of the post-tonic consonant do not generally have an effect. However, /ɪ/ is associated with more breathiness than /a/ ($p < 0.01$) and /a/ is associated with more glottalisation than /ɪ/ ($p < 0.001$), which agrees with [20].

3.2. Conditioning of glottal replacement

Glottal replacement, in so far as it can be identified in the acoustic signal, occurs word-finally and in one case also word-medially (*flatter* [flaʔə]). Only the monosyllabic context was subject to further analyses of glottal replacement.

Within the plosive data, the phenomenon is found in 43 items, i.e. in 25% of monosyllabic tokens. A Mixed Effects Model revealed that the phenomenon is sensitive to the place of articulation of the following plosive: /t/ is associated with most instances of glottal replacement, followed by /p/, which is then followed by /k/ in the frequency of glottal replacement. The differences between the places are significant (/t/ vs /p/: $p < 0.05$; /p/ vs /k/: $p < 0.01$). This is shown if Figure 8, where the places of articulation are ordered from the least to the most favourable for glottal replacement.

Figure 8: Glottal replacement and the place of articulation of the post-tonic plosive.



Vowel height significantly affects glottal replacement only regarding /ʊ/ and /ɒ/: the lower vowel occurs with more glottal replacement than the high vowel.

Within the fricative data, there are 6 tokens with glottal replacement. This process only affects /f/ and /θ/ in the tokens produced by two speakers. The low number of fricative tokens with glottal replacement renders statistical analyses far from useful, and because these two fricatives tend to exhibit low energy, articulatory analyses would be more reliable for further analyses.

4. DISCUSSION

The answers to the questions raised in the introduction are as follows:

1. Pre-aspiration does occur in Manchester English.
2. The relationship between pre-aspiration and glottalisation is phonological and determined by prosody in the plosive context: pre-aspiration occurs word-medially ([lʊʰkʰɪ]) and glottalisation word-finally ([lʊʔkʰ]). A different relationship has been found in the fricative context: whilst pre-aspiration occurs obligatorily with fricatives, this is not the case for glottalisation. There is some evidence that the latter – but not the first – is conditioned segmentally.

In addition, it was found that glottal replacement can affect both plosives and fricatives, although this is very infrequent in the fricative context. Glottal replacement and glottalisation (glottal reinforcement) should be considered the same phenomenon when the relationship between glottalisation and pre-aspiration is analysed. The results further suggest that breathiness and pre-aspiration should likewise be considered the same phenomenon in such analyses (but see [1] for arguments to the contrary).

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