Phonetic variation in Northern Wales: preaspiration

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1. Abstract

Preaspiration (aspiration preceding the closure of a voiceless stop) is typologically rare (Laver 1994: 356) and, in the case of many languages and dialects in North West Europe, is noted as being an areal phenomenon. In some varieties preaspiration has been normalised in the phonology, whereas in others it occurs as a non-obligatory feature (Helgason 2002: 21-23). The aim of this paper is to ascertain whether preaspiration is present in the repertoire of Welsh-English bilinguals in North Wales.

Data was collected via word-list from four Welsh-English bilinguals and was analysed acoustically. Preaspiration was detected in 60.5% of Welsh tokens and was also found, to a lesser extent, in the English tokens (33.3%). As in previous studies, preaspiration is more common in female speech (78.3%) than amongst males (57.7%). The female informants, who were also more active users of the language, were significantly more prone to produce preaspirated English tokens.

Key words: Preaspiration, Welsh, English, phonetics, bilingualism

2. Introduction

It has been noted that preaspiration, that is to say aspiration preceding the closure of a voiceless stop, seems to be rare amongst the world's languages (cf. Laver 1994: 356). Although preaspiration has been found to occur in non-European languages such as Halh Mongolian (cf. Svantesson 2003), it occurs most frequently in the languages and dialects of North-Western Europe (cf. Helgason 2002: 3), such as the North Germanic (Scandinavian) languages, Saami, Scots Gaelic, and Tyneside English (cf. Docherty & Foulkes 1999). The aim of the paper is to examine whether preaspiration is a feature in the varieties of English and Welsh spoken in northern Wales[i]. I will firstly provide a definition of preaspiration and present an overview of previous studies, before proceeding to the Welsh and Welsh English data.

3. Defining preaspiration

There remains to be a clear consensus regarding the true nature and definition of preaspiration. Ladefoged and Maddieson state that 'there is a period of voicelessness at the end of the vowel, nasal, or liquid preceding the onset of the stop closure' (1996: 70).

Aspiration following a nasal or liquid has been separately defined as sonorant devoicing (cf. Helgason 2002: 11) and, whilst seen as related, is largely referred to separately in the literature (cf. Stevens & Hajek 2004). The most widely accepted definition, summarised by Helgason, is that preaspiration 'is a period of (usually glottal) friction that occurs between a vocalic and consonantal interval' (2002: 9). This friction occurs between a subset of sounds, namely voiceless stops[ii]. Silvermann maintains in his survey of the literature that preaspiration can be viewed as 'a cover term for a variety of configurations which typically involve a spirant largely homorganic to a following oral closure […] and/or a spirant that is influenced by the preceding vowel quality' (2002: 575).

4. Case studies

Due to its prevalence in Scandinavian languages it has been posited by Hansson that a sound change in Proto-Scandinavian led to preaspirated geminate consonants /pp,tt,kk/, which remained in the subsequent languages and dialects (2001: 170). The preaspiration of geminate consonants can be seen in Icelandic, but it also occurs after short vowels and before fortis stops, in word-medial or word-final position (cf. Ladefoged & Maddieson 1996: 70). In this way, the presence of preaspiration distinguishes between the fortis and lenis stops (cf. Helgason 2002: 48-49). In both Icelandic and Faroese, where the occurrence of preaspiration is normalised in the phonological system, it is said to be a normative trait of the language (cf. Helgason 2002: 21-23). Conversely, if the presence or absence of preaspiration does not result in a deviant pronunciation, then it is said to be a non-normative feature of the language. Both normative and non-normative preaspiration feature in dialects of Swedish and Norwegian: Wretling et al. examined twenty Northern Swedish dialects and found that although preaspiration occurred in all them, it occurred considerably more for two dialects (those of Vemdalen and Arjeplog) and could be considered as normative (cf. Wretling et al. 2002). In Southern Swedish, Tronnier found that longer preaspiration occurred after short vowels and before long consonants (as in Icelandic) but it was also present after long vowels and before short consonants, making preaspiration non-normative (cf. Tronnier 2002). The languages which are thought to have developed preaspiration via contact with North Germanic are Skolt and Lule Sami (cf. McRobbie-Utasi 1991 and Engstrand 1987), and Scottish Gaelic. Of Scottish Gaelic, it has been noted that there are several patterns of realisation dependent on dialect, ranging from no preaspiration (in the dialect of Lewis) to a homorganic fricative before all three voiceless stops (in other Hebridian dialects,represented as /xp/, /xt/, and /xk) (cf. MacAulay 1992: 155, Ní Chasaide & O Dochartaigh 1984: 142, cited in Laver 1994: 357). The influence of Scottish Gaelic on the English phonology of the area is claimed by Wells, who states that 'in the Gaelic-influenced speech in the Highlands and Islands, however, strong aspiration is the rule; and in this accent, indeed, not only are initial voiceless plosives in a stressed syllable post-aspirated, but final ones are pre-aspirated' (1982: 409, see also Gordeeva & Scobbie 2004). This has also been found in the English of Middlesbrough (cf. Jones & Llamas 2003) and Newcastle (cf. Docherty and Foulkes 1999). Docherty and Foulkes (1999) found that glottal frication occurred before /p/, /t/, and /k/. This occurred at a rate of 70% of young females (aged 14-27) compared with 35% of young males, which led the authors to conclude that extended frication was an example of a 'change from above' with females leading the

change. Though the high rate of preaspiration amongst females may be explained by sociolinguistics, there is a common trend for it to be more prevalent amongst females. Helgason attributes this to physiology, stating that 'preaspirations might ultimately be caused by fortuitous effects in the transition from modal voice to voicelessness that are generally more prominent in the voice source of females (and children) than in males' (2002: 231). The physiological affect on preaspiration has also been cited as a reason for differences in the length of preaspiration before particular stops (cf. Péttursson 1972: 64).

5. Methodology

Tokens were obtained from four speakers (two males and two females), all of whom resided in North Wales, and spoke northern varieties of Welsh (cf. Ball 1988: 19-20). The speakers were aged between 14 and 27 and had acquired Welsh via parental transmission. Recordings were made in the informants' homes using a Roland EDIROL R-09 WAV/MP3 recorder with integrated microphone. The sampling frequency was set at 48 kHz and recordings were made in WAV 16Bit format. Tokens were embedded in the carrier phrase '*Dyweda* [test word]'/*'Dyweda* [test word] *eto'* ('Say X/Say X again). The words which were analysed were *brat* (apron), *atal* (to stop), *cacen* (cake), *mêt* (mate) and *map* (map). In order to compare preaspiration in both Welsh and English, the words 'battle' and 'mate' were also analysed, yielding a total of 168 tokens[iii]. Using Praat, both the total duration from the onset of voicing to the vowel to the closure for the stop and the preaspiration were measured. The vowel onset was characterised by a change in formant structure and increase in amplitude on both the spectrogram and waveform. Where voiced aspiration was present the waveform became gradually more sinusoidal accompanied by a change in formant structure. The voiceless aspiration that followed was identified by frication and energy in the higher frequency range of the spectrogram. The duration of the vowel is defined as the period of modal voicing during the production of the vowel and preaspiration has been measured as the period between the offset of modal voice and stop closure (see section 2). An example of *brat*, below, shows how preaspiration was measured:

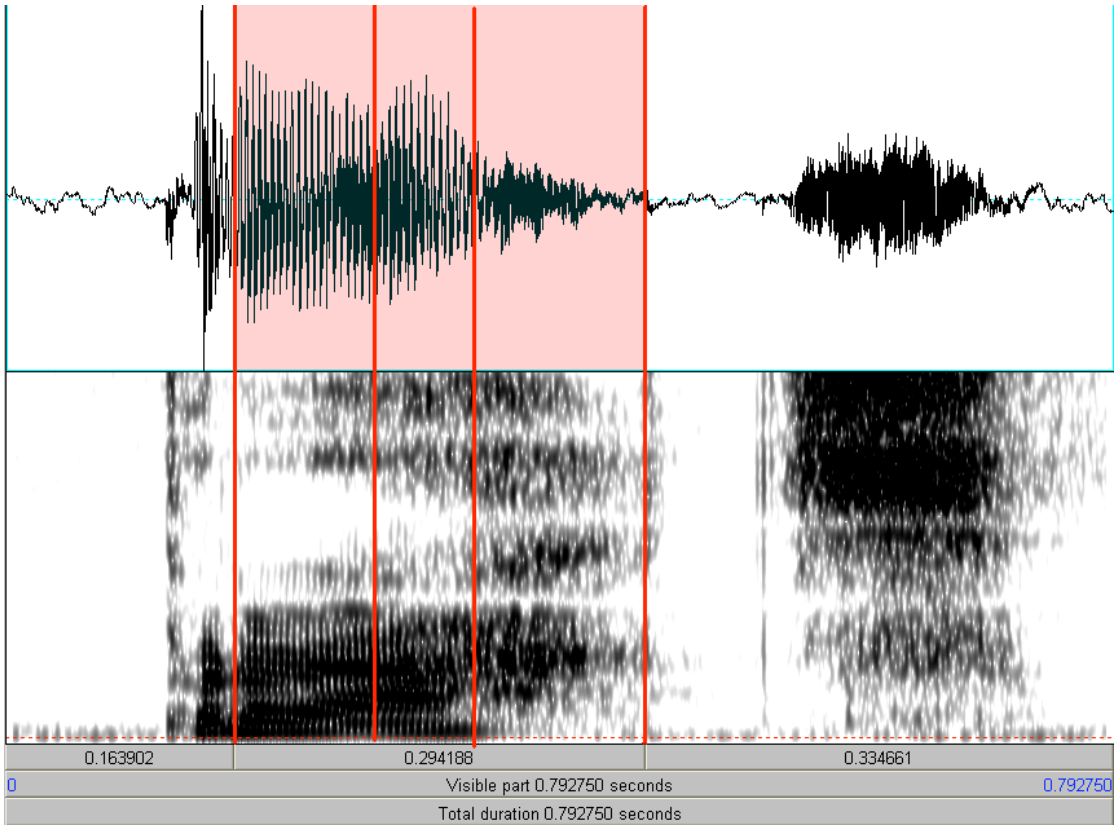

Figure 1: Spectrogram showing how preaspiration was measured.

The highlighted portion of the spectrogram indicates the complete vowel, from the onset of modal voicing to the constriction for the closure. Section A indicates modal voicing for the vowel. Section B indicates the end of modal voicing (shown by formant transitions) and the onset of breathy voicing. Section C indicates voiceless aspiration. The duration of preaspiration was measured as sections B and C combined.

6. Welsh data

6.1 Frequency of occurrence

Preaspiration was found in 72 out of 119 Welsh tokens, yielding a percentage of 60.5%. Very few studies of the Scandinavian examine overall rates of preaspiration, especially as it is obligatory in dialects where it is a normative feature. In Newcastle English, it occurred at a rate of 32.8% (cf. Docherty & Foulkes 1999: 66). As preaspiration did not occur for 100% of any of the test words (see also section 4.3), it appears that this preaspiration is non-normative and not seen as obligatory realisation in Northern Welsh dialects.

Previous studies have concluded that there is trend for females to produce more preaspirated stops (see section 2.2), and this was mirrored in this study. 78.3% of female tokens (47 out of 60) were preaspirated compared to 57.7% for males (34 out of 59). Figure 2 below shows this difference, which was found to be statistically significant (p=0.015).

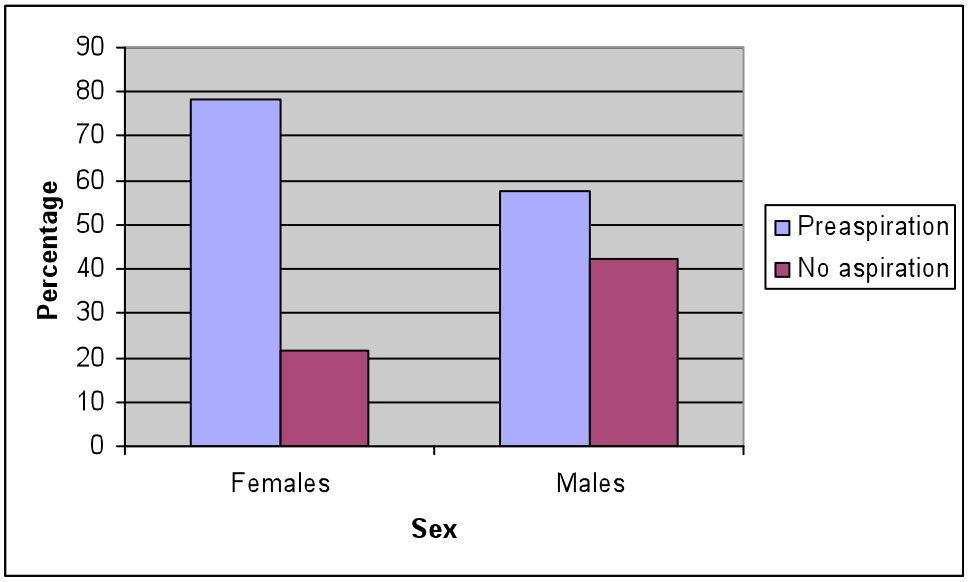

Figure 2: Percentage of preaspirated and unaspirated stops by sex.

As the data in this study is not more stratified in terms of age and dialect area, we cannot claim that preaspiration is a linguistic innovation within the language which females are adopting, as maintained by Docherty & Foulkes regarding Newcastle English (1999). It is of interest however that the female respondents have the most contact with the Welsh language by living in North-West Wales, which may suggest that preaspiration is more common in this dialect. Another distinguishing feature between the two male and two female respondents is the treatment of English loanwords. All instances of preaspiration for the borrowing *mêt* (6 out of 24 tokens) were found in speaker F19's speech. The word *map* is longer established in the Welsh language and was preaspirated more, although 78.6% of these tokens were produced by females (11 out of 14). If we examine instances of preaspiration word by word, as shown in Table 1 below, we can see that there is a range of 25% (*mêt*) to 91.7% (*atal*).

	N	%
Atal	22	91.7
Brat	17	70.8
Map	14	58.3
Cacen	13	56.5
Mêt	6	25

Table 1: Percentage of preaspirated tokens for each of the test words.

It was noted in section 2.2 that preaspiration is found before voiceless stops in word-medial and word-final position. Jones notes that postaspiration in Welsh is weaker word-medially (1984: 42). This is not the case for preaspiration, as 74.5% of instances of *cacen* and *atal*

were preaspirated (35 out of 47) compared with 51.4% of tokens in (37 out of 72). This is exemplified in Figure 3 below:

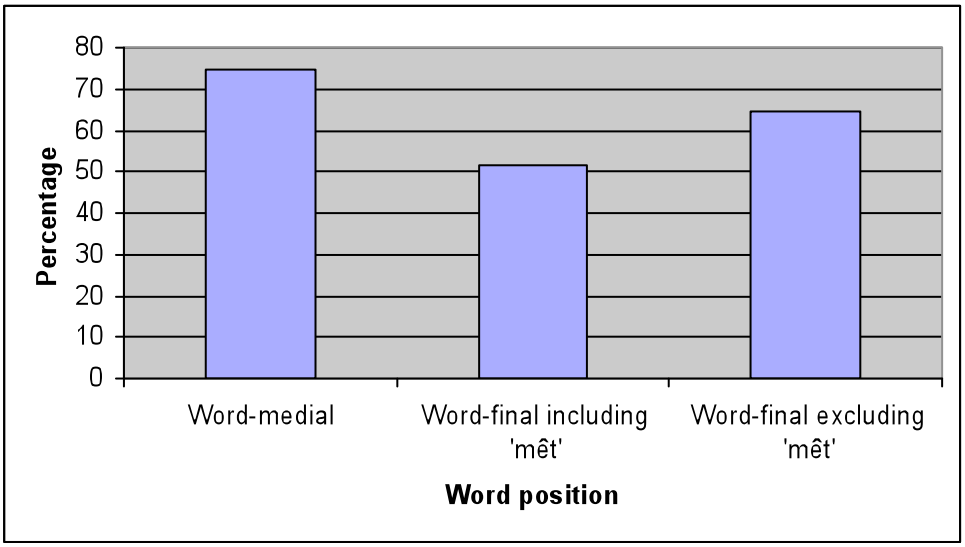

Figure 3: Percentage of preaspirated tokens produced by word position of the voiceless stop.

This difference in word position was found to be significant (p=0.01). However, this difference can largely be attributed to the relatively infrequent rates of preaspiration found in *mêt*. If we remove *mêt* from the data then 64.6% of the tokens with a stop in word-final position contained preaspiration and the difference in word position is not found to be significant (p=0.3).

In relation to the following voiceless stop, there is no significant difference found between it and the presence of aspiration (p>0.5), although there is a slight tendency for preaspiration to be more common before /t/ than /p/ and /k/:

	N (total number)	Percentage of preaspiration
/t/	45 (72)	62.5
/p/	14 (24)	58.3
/k/	13 (23)	56.5

Table 2: Number and percentage of preaspirated tokens before /t/, /p/, and /k/.

6.2. Duration

From Table 3 we can see that the duration of preaspiration ranges from 75 – 136ms. The range in Scottish Gaelic was found to be 50-100ms (cf. Ladefoged et al. 1998: 10), although this difference could be due to measurement techniques

Word	Total (ms)	Preaspiration (ms)
Cacen	129	78
Atal	137	75
Map	173	77
Brat	244	136
Mêt	312	82

Table 3: Mean total duration and duration of preaspiration for *cacen*, *atal*, *map*, *brat,* and *mêt.*

Helgason notes that not only do females tend to preaspirate voiceless stops more frequently than males, the duration is longer (cf. Helgason 2002: 93). With this in mind, let us firstly examine the differences in duration for males and females, as shown in Table 4 below:

Word	Mean preaspiration for females (ms)	Mean preaspiration for males (ms)
Cacen	79	76
Atal	81	70
Map	82	58
Brat	138	110
Mêt	82	-

Table 4: Mean duration of preaspiration for males and females.

The data shows that the female informants not only produced more tokens featuring preaspiration than the males, but the duration of the preaspiration is longer. This is exemplified in the following spectrograms:

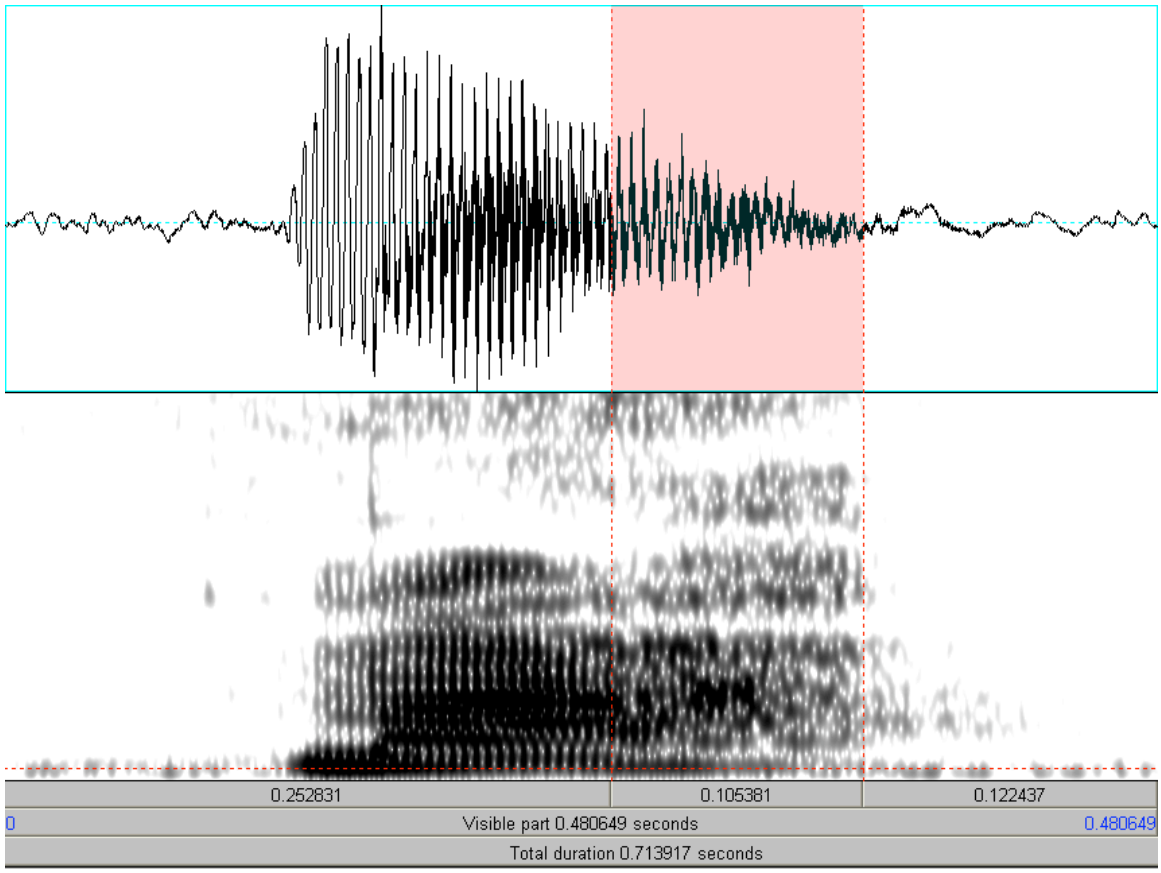

Figure 4: Spectrogram showing preaspiration in *map*, produced by speaker F27.

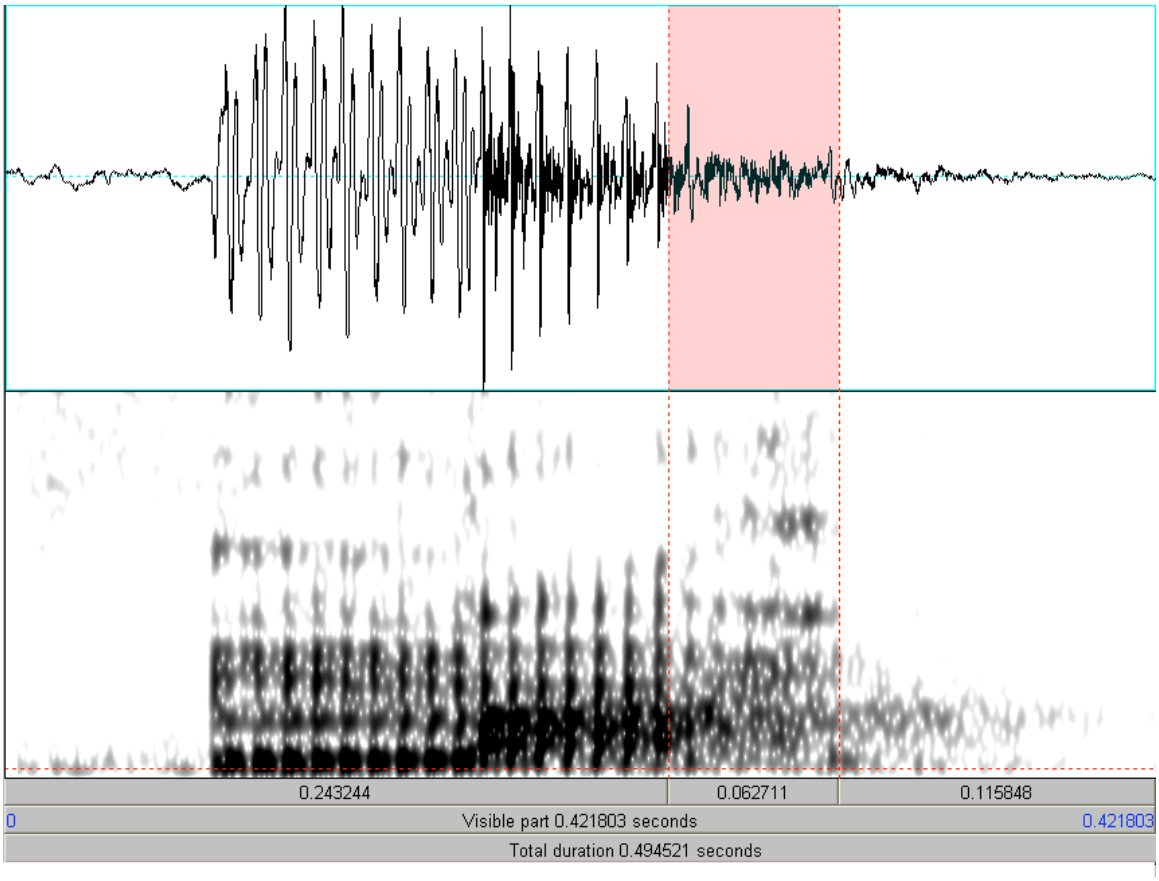

Figure 5: Spectrogram showing preaspiration in *map*, produced by speaker M26.

The highlighted sections of the spectrograms begin at the offset of modal voicing and the start of preaspiration. The duration of the female's preaspiration is 105ms compared to 63ms for the male. It is interesting to note that the F27 has produced more breathy voice than M26, which adds to her preaspiration duration. Further studies would be needed in order to ascertain whether this is more common in females, or indeed certain dialect areas.

As has been discussed in section 2.2, it is common for the voiceless bilabial plosive /p/ to have a lower duration of preaspiration than /t/ or /k/. This is shown to be the case in Welsh, as exemplified in Table 5:

	Mean duration of preaspiration
/p/	77ms
/t/	98ms
/k/	78ms

Table 5: Mean duration of preaspiration preceding the voiceless stops /p/, /t/, and /k/.

Due to the differing parameters used to measure preaspiration it does not seem wise to compare the actual duration with the data from other studies. However, the Welsh data mirrors the studies of Scottish Gaelic and Icelandic (see section 2.2) that show preaspiration to be shorter for /p/ than the other voiceless plosives. Interestingly, however, aspiration before /k/ is closer to that of /p/ than that of /t/, which conflicts with the other studies.

As was discussed in section 4.2, there is no conclusive evidence to suggest that preaspiration is more frequent before stops in either word-medial or word-final position. The same is true for word position and duration of preaspiration, as is shown in Figure 6 below:

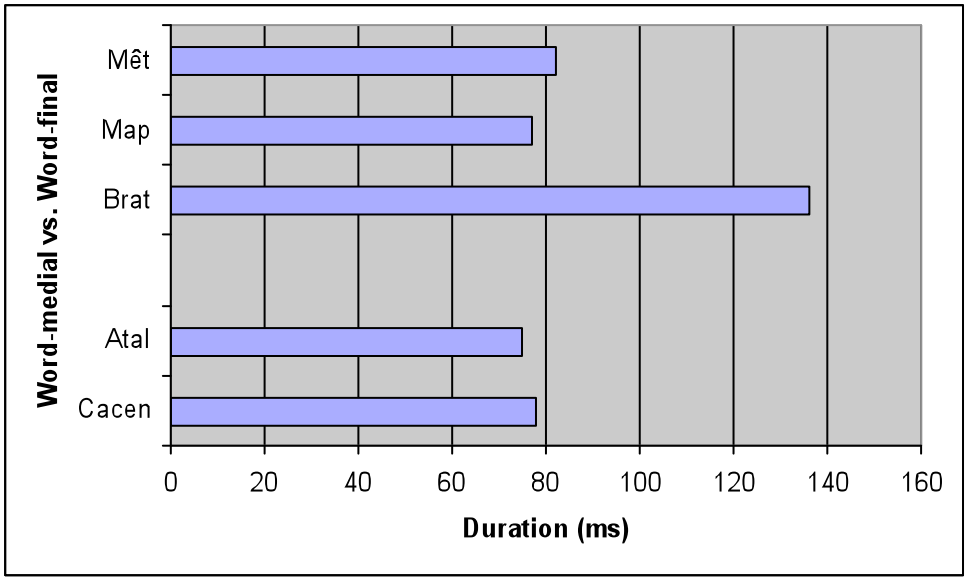

Figure 6: Duration of preaspiration before voiceless stops in word-medial and word-final position.

The two longest durations of preaspiration are to be found in *brat* (136ms) and *mêt* (82ms). Given that the word-medial tokens *atal* (75ms) and *cacen* (78ms) compare with the remaining word-final token *map* (77ms), it appears that word position does not affect duration. The modal voicing in *brat* and *mêt* have the longest duration of all the tokens, as shown in Table 6:

Test word	Duration of modal voicing	Duration of preaspiration
Brat	108ms	136ms
Map	96ms	77ms
Atal	62ms	75ms
Cacen	51ms	78ms
Mêt	229ms	82ms

Table 6: Duration of modal voicing and preaspiration.

It has been noted by Ball that the average length of vowel varies according to syllable structure (cf. Ball 1984:11). Modal voicing is longer when the vowel appears in monosyllabic words. It is apparent, however, that the duration of modal voicing does not necessarily mean a longer period of preaspiration.

7. English data

As stated in section 3, tokens were also made of English words in order to ascertain whether preaspiration occurs in English, as has been found in Gaelic influenced parts of Scotland (see section 3). Indeed, preaspiration was found to occur in the English tokens, and their frequency is noted below:

Test word	*N* (total)	%
Battle	14 (24)	58.3
Mate	2 (24)	8.3
Total	16 (48)	-

Table 7: Number and percentage of preaspirated English tokens.

It was expected that *mate* would show a level of preaspiration similar to that of *mêt*, given the phonological similarity. This turned out to be the case, with any differences being insignificant (*p=0.1*):

	Preaspirated tokens	Unaspirated tokens	Total
Mêt	6	18	24
Mate	2	22	24
Total	8	40	48

Table 8: Number of tokens produced with and without preaspiration for *mêt* and *mate.*

More surprising is the relative frequent occurrence of preaspiration in the word *battle.* The figures below show instances of *battle* and *atal* produced by speaker F19.

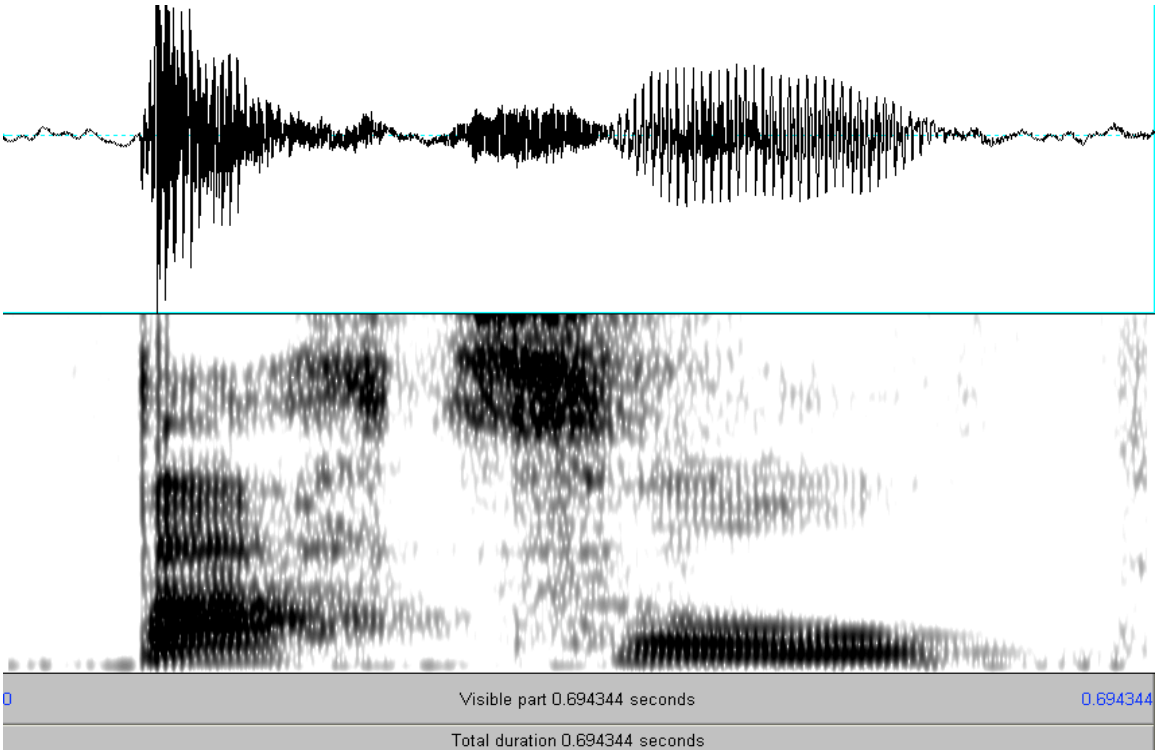

Figure 7: Spectrogram of *battle* showing preaspiration, produced by informant F19.

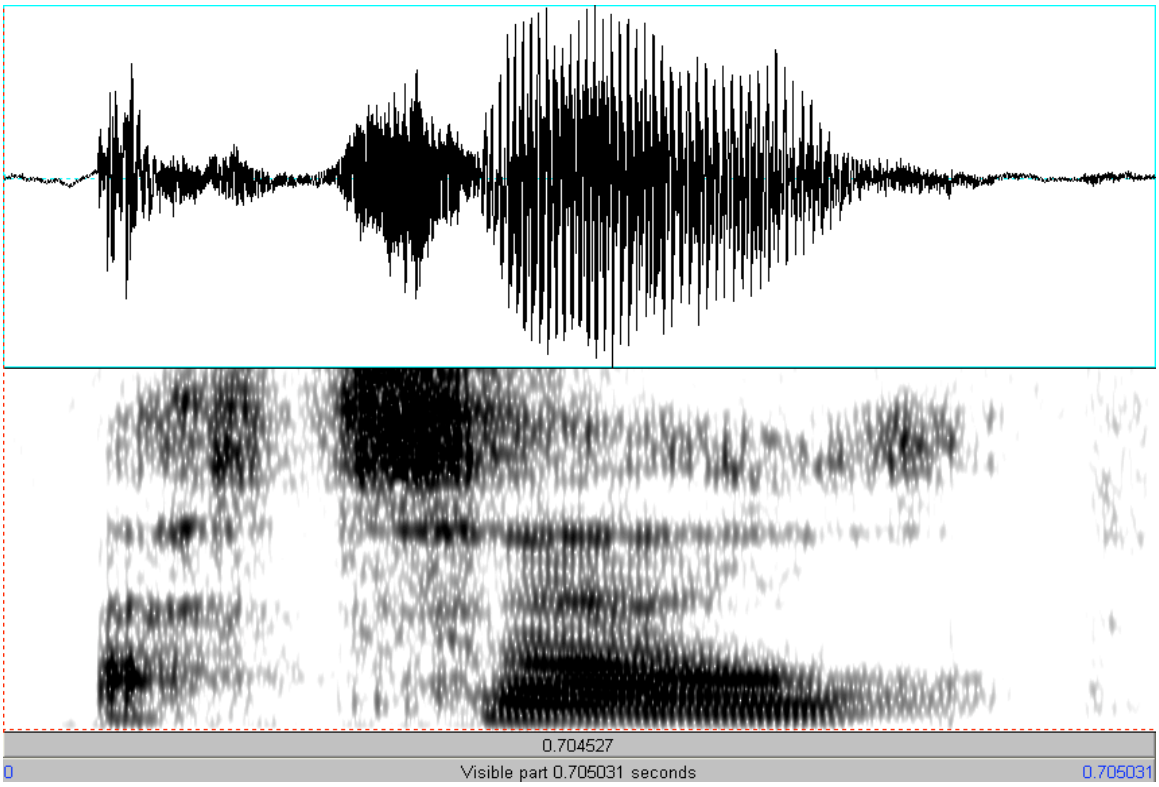

Figure 8: Spectrogram of *atal* showing preaspiration, produced by informant F19.

Both of the above spectrograms can be characterised by a loss of formant structure and high frequency frication that is associated with preaspiration. Although it is true that other studies have found preaspiration more likely after a short vowel and before a long consonant (as in *battle*), it is not my impression that this exists in the English of the area. The females were significantly more prone to preaspirate the English tokens ($p=0.01$), and did so for 12 tokens compared to 4 for the males. It does not seem surprising that Welsh phonology exerts more of an influence on English amongst those who use Welsh more frequently.

8. Conclusion

The data that has been presented in this study has confirmed that preaspiration is a feature of the Northern Welsh dialects, occurring in 60.5% of the Welsh tokens analysed. Due to the variation in the frequency of preaspiration we can also ascertain that it is a non-normative feature of the dialects studied. The differences between male and female respondents in relation to the frequency of preaspiration and its duration has also been significant, supporting previous literature which suggests that females have a tendency to preaspirate more, and for longer, than males. The fact that I have been unable to show significant differences between the frequency and duration of preaspiration in relation to the position of the following voiceless stop in the word and the vowel length highlights the need for a more thorough study to be completed with the inclusion of more dialect areas and informants.

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[i] To the author's knowledge preaspiration in Welsh and Welsh English has not been systematically studied, though the possibility that it is a feature of Welsh is mentioned in Ball (1984 :18).

[ii] There are increasing reports of preaspiration occurring with voiceless fricatives (cf. Gordeeva & Scobbie 2004, Jones & Llamas 2003). In line with the remit of this study, only aspects of preaspiration before voiceless stops will be examined.