INTERSPEECH 2023
20-24 August 2023, Dublin, Ireland

Aberystwyth English Pre-aspiration in Apparent Time

Míša (Michaela) Hejná[1], *Adèle Jatteau*[2]

[1]Aarhus University, Denmark
[2]University of Lille, CNRS, STL, France

misa.hejna@cc.au.dk, adele.jatteau@univ-lille.fr

Abstract

Do younger speakers of Aberystwyth English (Wales) pre-aspirate more than older ones? Previous research reports that they do, but finds a high degree of individual variation. We build on this work by enlarging the database with the inclusion of younger speakers. We confirm that pre-aspiration increases in frequency and duration in apparent time. We further investigate whether duration analyses are affected when zero duration values are excluded, that is, whether pre-aspiration is indeed longer in younger speakers, or whether it applies more frequently. We find that pre-aspiration applies obligatorily for the majority of speakers, so that excluding zero values does not affect the statistical results. Finally, we examine the interaction of pre-aspiration with pre-glottalisation, and show that pre-glottalisation tends to block the application of pre-aspiration, with individual-specific patterns. The interaction between the two is nevertheless not accounted for by age.

Index Terms: pre-aspiration, pre-glottalisation, Welsh English, sound change, apparent time

1. The social life of pre-aspiration

This study investigates pre-aspiration in apparent time: do younger speakers of Aberystwyth English (Wales) pre-aspirate more than older ones? We define pre-aspiration as a period of (primarily) glottal friction occurring in the sequences of sonorants/vowels and phonetically voiceless obstruents [1], as in Welsh English *bet* [bɛʰtˢ]. Although pre-aspiration has been studied for languages spoken in all five continents [1], few studies consider the role of social factors. While gender/sex is the most consistently targeted social factor in pre-aspiration studies, age has also been considered in apparent-time studies of pre-aspiration in Arjeplog Swedish [2], Lewis Scottish Gaelic [3], and varieties of English such as Hebrides English [4], Tyneside English [5] and Aberystwyth English (Wales, henceforth AE; first author of this study in [6]). The last two studies stand out as they suggest that pre-aspiration is increasing in frequency and duration in these two varieties of English, while it has been found to be receding in Swedish, Scottish Gaelic and Hebrides English. Moreover, [6] is the only one using age as a gradient parameter rather as a categorical variable comparing age groups, suggesting that gradient approaches to age may be more optimal in some cases (e.g. [7] on age as a variable). However, [6]'s results raise a number of questions. In particular, [6] reports that the younger the speaker, the more frequent and the longer the pre-aspiration, but also that there is a considerable amount of individual variation. The goal of this paper is to build on this work by including even younger speakers, in order to address the general following question:

- Is pre-aspiration undergoing a sound change in AE?

[6] is based on 12 speakers born prior to 1995. We first enlarge the database to include 6 younger speakers and one additional older one. Secondly, [6] reports that pre-aspiration varies along two dimensions: 1) the rate of application (whether pre-aspiration applies or not), and 2) its duration. Importantly, cases where pre-aspiration does not apply (duration is 0ms) are often included in the durational analyses of various pre-aspiration studies. This approach is potentially problematic: when 0 duration values (that is, non-application of pre-aspiration) are included in durational analyses, the two potentially independent dimensions of variation are conflated. In this light, we also ask the following:

- Is pre-aspiration duration in AE sensitive to age also when zero values are excluded?

Answering this question enables us to shed light on the type of the change, that is, whether younger speakers apply pre-aspiration more frequently, and/or for a longer duration.

Finally, pre-aspiration has been shown to be blocked by pre-glottalisation (that is, *nap* realized as [naˀp]) in Scottish Standard English, Manchester English, and American English [1, 6, 8, 9, 10], and also in a number of speakers of Welsh English [6]. Pre-aspiration and glottalisation can interact in a range of ways. For instance, a speaker may only glottalise in environment A and only pre-aspirate in environment B. However, this type of allophonic relationship between glottalisation and pre-glottalisation can also be more gradient: one can be more or less likely than the other in the same environment. [11] also mentions the possibility of glottalisation and pre-aspiration co-occurring in the same tokens. Even in this (apparently rather rare) case, however, there is a tendency for the two phenomena to disprefer one another in the same environment and in the same tokens. Our last question is therefore the following:

- How does pre-glottalisation interact with pre-aspiration in AE? If it does, does this interaction change in apparent time?

2. Methodology

2.1. Speakers

The dataset used in this study is built from two larger datasets of AE (see 2.4), and includes 19 speakers born between 1924 and 2004 (Table 1). Only two of the speakers are male. All speakers labelled as ABE were born and raised in Aberystwyth. GOG1 was born and raised in Goginan, which is located approximately 7 miles east of Aberystwyth. She is included because she does not behave differently than the Aberystwtyh speakers. Furthermore, all speakers are L1 speakers of Welsh who are also proficient in English.

10.21437/Interspeech.2023-206

Table 1: *Social characteristics of the speakers.*

Speaker	Sex	DOB
ABE14	Female	1924
GOG1	Female	1940
ABE31	Female	1942
ABE18	Female	1944
ABE17	Female	1954
ABE46	Female	1956
ABE12	Female	1960
ABE24	Female	1966
ABE33	Female	1982
ABE37	Female	1986
ABE50	Female	1988
ABE45	Female	1990
ABE52	Female	1992
ABE58	Female	2000
ABE55	Female	2001
ABE59	Male	2002
ABE56	Female	2003
ABE60	Female	2004
ABE57	Male	2006

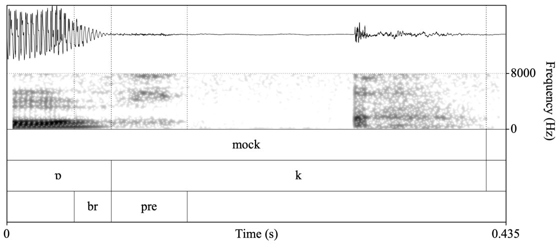

Figure 1: *Local breathiness and voiceless pre-aspiration.*

2.2. Quantifying pre-aspiration

We define pre-aspiration as the glottal friction in sequences of vowels and voiceless obstruents, as in *bet* [bɛʰtˢ]. We distinguish two components: local breathiness (labelled as 'br' in Fig. 1) and voiceless pre-aspiration (labelled as 'pre' in Fig. 1). For the criteria used to identify the onset and offset of voiceless pre-aspiration and of voiced breathiness, the reader is referred to [1, 6] and Hejná (2016).[1]

2.3. Quantifying pre-glottalisation

We define pre-glottalisation as an aperiodic vocal fold vibration and/or as a sudden drop in f_0, in line with other studies (e.g. [9, 12]).

2.4. Data and procedure

The data for ABE12-52 was collected in 2013-2014, using an H4 Handy Zoom recorder and a head-mounted AKG C520 microphone. The data for the remaining speakers was recorded in 2017, using the same head-mounted microphone, and an H5 Handy Zoom recorder. The data was sampled at 44.1 kHz. Larger datasets were collected on both occasions. For the purposes of this study, only words are used which are recorded for both groups of speakers. These include the following: *back, backer, bat, bock / dock, cap, capper, carp, caught, cot, hack, hat, hock, hop, lacquer / knacker, mac, mark, mat, mock, mop, nought, pack, packer, park, pat, port, pot, tap*, and *tock*. *Bock* and *lacquer* are available from the 2013-2014 dataset. In the 2017 dataset, *dock* and *knacker* were considered structurally sufficiently similar to *bock* and *lacquer*. This dataset is different from that in [6] in that the segmental and prosodic environments are more limited (no high vowels, less dissyllabic words).

Three repetitions of each word are included in the analyses per speaker. In the 2017 dataset, these are uttered in the carrier sentence *Say ___ one more time*. In the 2013-2014 corpus, two tokens of each type are uttered in the carrier sentence *Say ___ again*, and one in isolation. After excluding some tokens due to mispronunciation, presence of postvocalic /r/ in words such as *port*, and various technical issues, each speaker produced 76-84 tokens. In total, this yielded 1548 tokens.

Annotations were done in Praat [13]. Statistical analyses were done in RStudio [14], using `lme4` [15], `lmerTest` [16], and the `effects` [17] packages.

3. Results

3.1. Pre-glottalisation and pre-aspiration

Some pre-glottalisation is found in our data, and it is used very frequently by at least one of our speakers. In total, 155 of the tokens show glottalisation (11%). 4 speakers never pre-glottalise (ABE18, ABE55, ABE59, GOG1) and 12 speakers produce between 1-6 tokens with pre-glottalisation (ABE12, ABE14, ABE17, ABE24, ABE31, ABE33, ABE45, ABE52, ABE56, ABE57, ABE58, ABE60). For these speakers, pre-glottalisation can co-occur with pre-aspiration in the same tokens and environments. Three speakers produce somewhat higher numbers of pre-glottalisation. ABE46 produces 9 tokens with pre-glottalisation (12% of her tokens). Visual inspection shows a near-categorical allophony between pre-aspiration and pre-glottalisation for this speaker. ABE50 pre-glottalises 37 of her tokens (45%), and shows a gradient allophony between pre-aspiration and pre-glottalisation, where the two disprefer one another. Finally, ABE37 produces pre-glottalisation in 74 of her tokens (89%), which correspond to all of her monosyllabic words. For ABE37, pre-glottalisation blocks pre-aspiration in monosyllabic words (e.g. *ca*[ˀ]*t*, but not *ca*[ˀ]*tty*). While ABE37, ABE46 and ABE50 are not amongst the oldest of our speakers, they are importantly not amongst the youngest either. Their behaviour is difficult to account for (primarily) by age.

3.2. Pre-aspiration frequency and duration

In total, 1338 of the tokens show voiceless pre-aspiration (87%) and 1389 tokens show local breathiness (90%). Most of the speakers produce voiceless pre-aspiration at the rates of 94-99%. Four speakers fall within the range of application of 86-89% and one pre-aspirates in 72% of her data. Two speakers diverge from this overall pattern of near-obligatory application. Firstly, ABE37 pre-aspirates only 18% of her tokens. This is explained by pre-glottalisation blocking pre-aspiration in her monosyllabic words. The second speaker is ABE50, who pre-aspirates in 64% of her tokens. Importantly, ABE37 categorically glottalises the monosyllabic tokens, whereas ABE50 does not do so categorically, albeit to a high degree.

Local breathiness mirrors the individual patterns reported

[1] M. Hejná, Pre-aspiration: manual on acoustic analyses 1.1., unpublished manuscript archived on LingBuzz, `https://misprdlina.files.wordpress.com/2012/10/hejna2016b.pdf`, 2016.

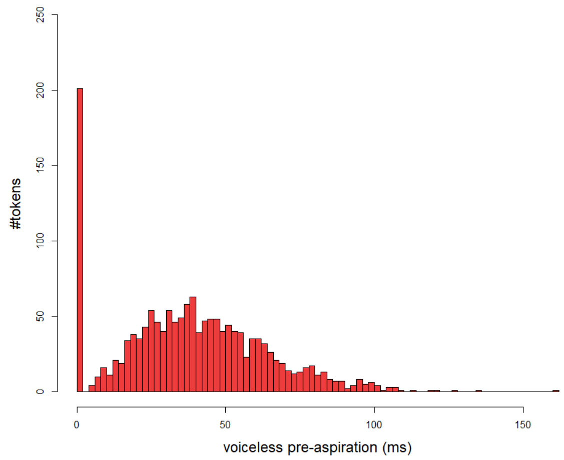

Figure 2: *Distribution of voiceless pre-aspiration durational values (ms).*

Table 2: *Pre-aspiration duration.*

Pre-aspiration	Min	Median	Max
Voiceless pre-aspiration (ms)	0ms	38ms	162ms
Voiceless pre-aspiration (%)	0%	7%	27%
Voiceless pre-aspiration without zero values (ms)	5ms	42ms	162ms
Voiceless pre-aspiration without zero values (%)	1%	8%	27%
Local breathiness (ms)	0ms	36ms	226ms
Local breathiness (%)	0%	7%	35%
Local breathiness without zero values (ms)	5ms	36ms	226ms
Local breathiness without zero values (%)	1%	7%	35%

for pre-aspiration: most speakers show 98-100% of application rate, and three speakers show 94-95%. Three speakers stand out. ABE14, the oldest speaker, shows 62% of application rate, and the three most frequent glottalisers display values of 87% (ABE46), 70% (ABE50), and 16% (ABE37).

Regarding the durational measurements, as shown in Fig. 2, the distribution of voiceless pre-aspiration shows a bimodal distribution across the speakers: zero values form a separate peak. This suggests the presence of a categorical rule (pre-aspiration applies or not). However, when inspecting individuals, only 7 speakers unambiguously show a bimodal distribution (ABE14, ABE17, ABE37, ABE46, ABE50, ABE55, ABE56). Looking at breathiness, bimodal distribution emerges unambiguously in only 4 speakers (ABE14, ABE17, ABE37, ABE50). These patterns do not suggest an age-related explanation. However, the behaviour of ABE37, ABE46, and ABE50 can be accounted for by pre-glottalisation blocking pre-aspiration.

The average durations for voiceless pre-aspiration and local breathiness are summarised in Table 2. The values reflect both the inclusion of zero values and their exclusion. Normalised durations are expressed as a percentage of the overall word duration.

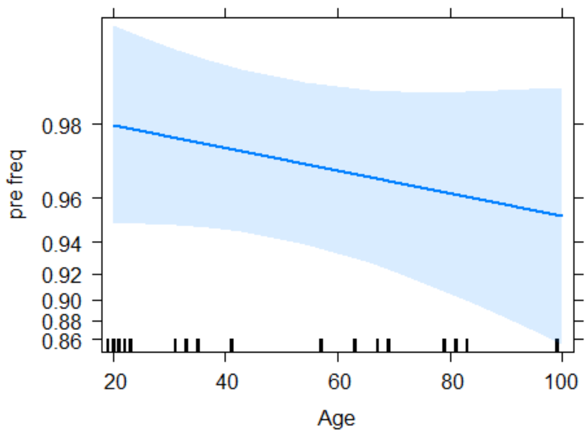

Figure 3: *Voiceless pre-aspiration application and age.*

3.3. Age and pre-aspiration

In order to shed light on the potential effects of age on pre-aspiration, mixed effects models were constructed which included the following dependent variables: voiceless pre-aspiration frequency, breathiness frequency, overall pre-aspiration frequency, voiceless pre-aspiration duration (raw or normalised), breathiness duration (raw or normalised), and the duration of overall pre-aspiration (raw; i.e. the combination of voiceless pre-aspiration and local breathiness). The independent variables were always those of age, pre-glottalisation (2 levels: present, absent), C1 type (4 levels: fortis fricative, fortis plosive, lenis plosive, sonorant), and word and speaker were entered as random effects. The inclusion of any other variables resulted in non-convergent models. Because of her divergent pattern of obligatory pre-glottalisation categorically blocking pre-aspiration, ABE37 was excluded from all models.

We report that although the frequency of pre-aspiration is higher for the younger the speakers when visually inspecting the data (Fig. 3), this effect is nevertheless not significant ($\beta = -0.01$; SE = 0.01; z =-1.1 p = 0.26). Pre-aspiration is however predicted by the presence of glottalisation: the presence of glottalisation is correlated with lower pre-aspiration application ($\beta = 2.3$; SE = 0.4; z = 5.9; $p < 0.0001$).

Breathiness frequency is sensitive to age: the younger the speaker, the more frequent the local breathiness ($\beta = -0.05$; SE = 0.01; z = -3.6; $p < 0.001$), as shown in Fig. 4. Again, glottalisation predicts a lower rate of breathiness application ($\beta = 3.08$; SE = 0.45; z = 6.8; $p < 0.0001$).

Turning to the durational analyses, as expected from the frequency results in 3.2 (most speakers do not show a bimodal distribution), including or excluding zero duration values does not affect the results, except for the effect of glottalisation (see below). We report the results including zero values. Moreover, the results for raw and normalised values are the same, and we therefore report only the raw values here.

Visual inspection suggests that the duration of pre-aspiration becomes longer as age decreases. This is nevertheless not confirmed as significant in the statistical model ($\beta < -0.01$; SE = 0.01; df < 18; t = -0.1, p = 0.92). However, pre-aspiration duration is negatively correlated with the presence of glottalisation ($\beta = 10.5$; SE = 2.3; df = 1425; t = 4.6; $p < 0.0001$). This effect disappears when zero values are excluded, confirming that when pre-glottalisation is present, pre-aspiration does

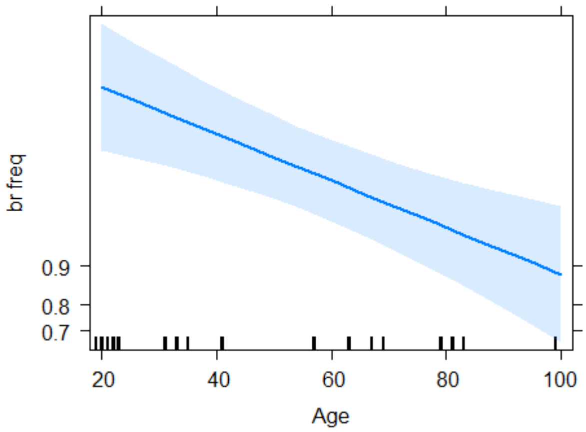

Figure 4: *Local breathiness application and age.*

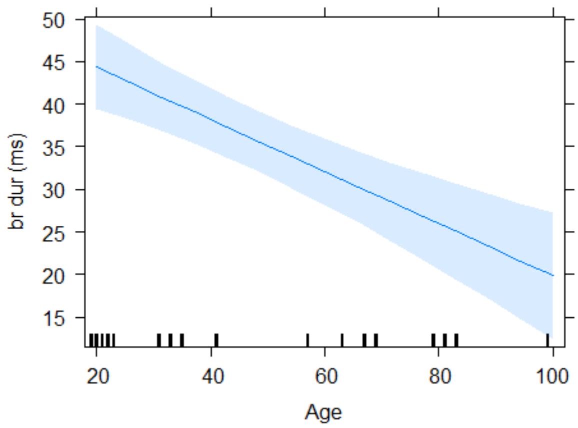

Figure 5: *Local breathiness duration and age.*

not tend to reduce in duration but rather tends not to apply.

Breathiness duration is longer the younger the speaker is (β = -0.3; SE = 0.06; df = 18; t = -4.8; $p < 0.001$), as shown in Fig. 5, and shorter if glottalisation is present (β = 7.5; SE = 2; df = 1445; t = 3.7; $p < 0.001$).

4. Discussion

The overarching question posed in this paper was whether pre-aspiration is currently undergoing a sound change in apparent time in Aberystwyth English, and whether this change is incremental. We do indeed find an increased application and duration of local breathiness: the younger the speakers, the more frequent and the longer the local breathiness is. Regarding the voiceless component of pre-aspiration, although visual inspection suggests that pre-aspiration does become slightly more frequent in apparent time, statistical analyses do not show change regarding either its frequency of application or its duration.

These results somewhat differ from [6], who found that both components of pre-aspiration increased significantly in the younger speakers analysed. Using even younger speakers, our study suggests that speakers born after 1995 only slightly support this tendency for pre-aspiration to become more frequent and longer in duration. We suggest that pre-aspiration has become near-obligatory in AE, and we may well be at the end tail of a potential sound change in both datasets.

Following up on the issues raised by [18], we considered the potential issue with conflating two dimensions of pre-aspiration: its application frequency and its duration. More specifically, the presence of a bimodal distribution of the pre-aspiration durations, with a separate peak for zero values, may reflect a phonological rule: does pre-aspiration apply or not. If that is the case, such zero values should be excluded from durational analyses, as they reflect a different dimension of variation. In the dataset analysed here, only a small number of speakers show such a bimodal distribution: rule scattering is not observed. Zero values can therefore safely be included in the durational analyses.

These results should however be interpreted with caution. Firstly, the current dataset is limited in terms of the prosodic and segmental variation when compared to that used by [6]. This may well be why most of the speakers analysed in [6] displayed a bimodal distribution, which indicates the presence of a phonological rule. Secondly, it needs to be borne in mind that the number of speakers included in this study is relatively small, especially when cross-tabulated with the variable of age. The smaller the size of an effect is, the less likely it may be that small datasets will prove sufficient to reveal the potential presence of rule scattering, even if it does in fact operate in a variety. A larger-scale study should ideally be conducted in future, with more than 19 speakers, and with a data better balanced for gender. Thirdly, future pre-aspiration studies should carefully examine the distribution of pre-aspiration in order to determine whether there is a categorical process operating in the data. Just because most individuals do not show a bimodal distribution in the dataset analysed here does not mean that this will be the case in all pre-aspiration studies.

Finally, we have also shown that pre-glottalisation is individual-specific in the data such that no obvious age-related differences emerge. The presence of pre-glottalisation nevertheless consistently emerges as a strong predictor of pre-aspiration and breathiness frequency and duration. If pre-glottalisation is present, pre-aspiration and breathiness are less likely to apply. As a result, they are also likely to be shorter in duration if zero values are included in the measurements. Here, at least, we observe the consequence of including zero values in durational analyses, which do indicate the operation of a rule, whereby pre-aspiration tends to be blocked by pre-glottalisation. The reader will find a more in-depth discussion of the relationship between pre-aspiration and glottalisation in [11].

5. Acknowledgements

We thank the participants for their very valuable time and all the kindness that they have offered us. This research was partially supported by the ANR grant DIPVAR (ANR-21-CE38-0019).

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