Summative Assessment

Introduction

This report details the analysis of the questioned utterance [X] in *Alston.wav*. Based on initial auditory response, the utterance was thought to be closer to 'Ray' or 'mate' than 'Mike'. Hence, the disputed utterance's initial consonant was examined and its vowel compared with other PRICE and FACE vowels that were produced by the suspect in the sound file.

Background

French (1991:202-205) discusses how disputed utterances often arise due to poor quality recordings and/or unfamiliar or ambiguous speech. The prosecution or defence may propose that disputed utterances are specific words which would favour their case; hence, forensic phoneticians are required to resolve these issues.

If disputed utterances are caused by background noise such as an ongoing low frequency hum from nearby electrical devices, then this may be filtered out without affecting the data. However, if this or any noise occupies the frequency range of speech sounds, it generally cannot be removed without also removing vocal elements.

On the other hand, unfamiliar or ambiguous speech will be submitted to auditory and acoustic analysis. A profile of the speaker's speech patterns will be created through human ear perception followed by a phonetic transcription and through computer-based methods, which provide specific detail about the physical properties of the signal such as formants and F0 level.

Materials

The composite sound file of phone calls *Alston.wav* (89.99s in length) was analysed using Creative HS800 headphones and version 4.6.38 of Praat, a freeware program for the acoustic analysis of speech provided by Paul Boersma and David Weenink of the University of Amsterdam. In addition, a transcription of *Alston.wav* was used to find suitable utterances for comparison.

Methods

Firstly, formant tracking was enabled in Praat and the number of formants displayed raised from 5.5 to 6 over a 5 KHz range. This was done in order to obtain the most accurate formant readings. It must be noted that formant tracking on the computer or by eye was not always easy regardless of formant settings and *Figure 1* illustrates a common issue with weak formants.

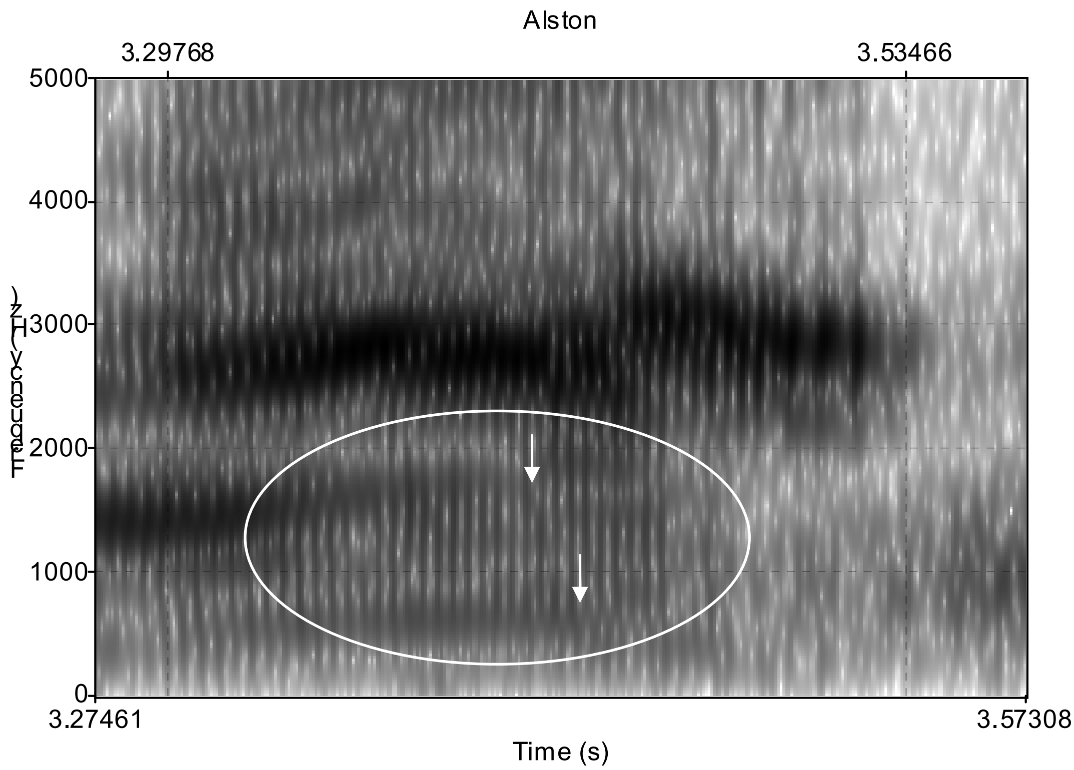

Figure 1: Spectrogram of [X] with vowel circled. Arrows indicate where the formant tracker and also reading by eye runs into difficulty.

Secondly, the consonant of [X] was scrutinised and then instances of PRICE and FACE vowels produced by the suspect were looked for in the recording. 7 instances of [aɪ] and 3 examples of [eɪ] were initially found; all 3 tokens of *mate* for the FACE vowel were workable but only 6 utterances with the PRICE vowel were kept. One token of *time* around 5 seconds into the recording was discarded due to noticeable nasalisation by the adjacent nasal consonant (see *Figure 2* below).

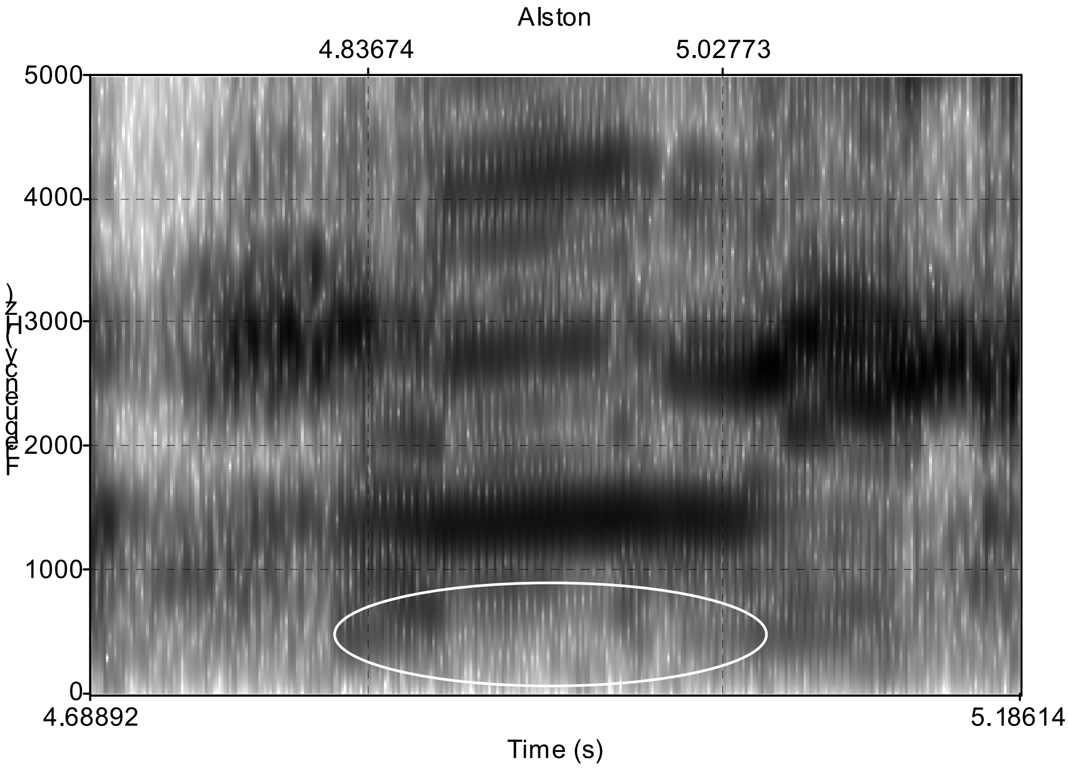

Figure 2: Spectrogram showing how nasalization has caused F1 to disappear (as discussed in Ladefoged, 2003: 135-136) making measuring *time's* F1 value unachievable

Following this, PRICE and FACE diphthong readings were gathered. Diphthongs are dynamic sounds in which the formant pattern changes due to a continuous articulatory movement from the initial to the final vowel position (Kent and Read, 2002:135-136). The English diphthong [aɪ], for example, is comprised of the nucleus [a] and the off-glide [ɪ]. As discussed in Ladefoged (2003:104), this dynamic formant movement means that two separate measurements need to be taken: one at the beginning and one at the end of the diphthong (yet as far away from adjacent consonants as possible). After extraction, values were entered into an Excel table (*Table 1*) and a vowel plot comparing the location and movement of the diphthongs was created (*Figure 3*).

Results

Vowel	Word	Element	F1	F2
X	*X*	nucleus	650	1650
		off-glide	521	1820
PRICE	*tonight*	nucleus	828	1556
		off-glide	745	1633
PRICE	*right*	nucleus	805	1514
		off-glide	1041	1536
PRICE	*right*	nucleus	698	1231
		off-glide	615	1775
PRICE	*time*	nucleus	793	1680
		off-glide	886	1668
PRICE	*find*	nucleus	887	1337
		off-glide	852	1219
PRICE	*tonight*	nucleus	805	1029
		off-glide	509	1053
FACE	*mate*	nucleus	780	1526
		off-glide	627	1775
FACE	*mate*	nucleus	751	1409
		off-glide	556	1893
FACE	*mate*	nucleus	740	1467
		off-glide	544	1727

Table 1: A table to show the F1 and F2 nucleus/glide values of the disputed utterance X's vowel compared with the nucleus and glide elements of PRICE and FACE vowel tokens in available utterances

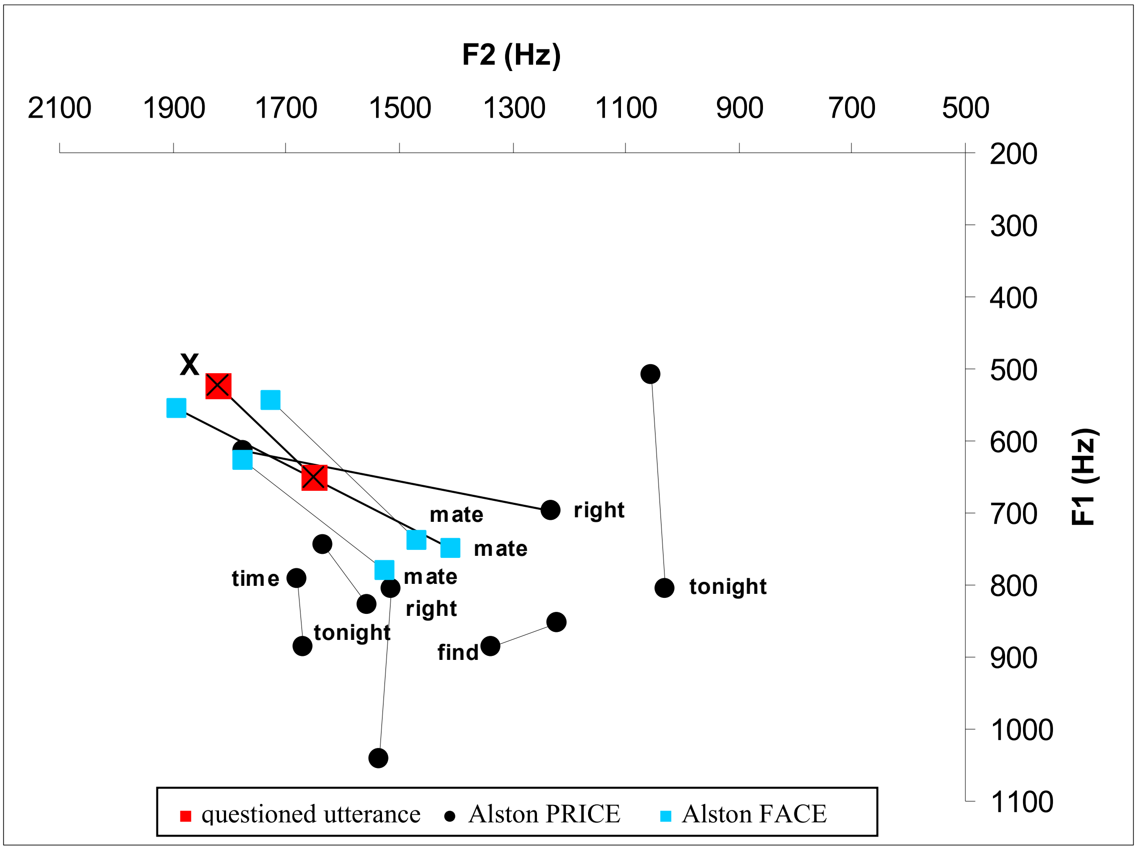

Figure 3: Vowel plot comparing the vowel in Alston's disputed utterance against PRICE and FACE vowel tokens. Tokens are labelled at the starting, nucleus vowel where possible in order to indicate direction of movement.

Table 1 highlights that F1 in the vowel of [X] fell by about 70 Hz whilst F2 rose by 170 Hz. The fall in F1 and rise in F2 is displayed across the board in the majority of both FACE and PRICE vowels, except for *time* (rise in F1), *find* (fall in F2) and the first listed token of *right* (rise in F1 and fall in F2). For PRICE vowels, the mean fall in F1 was 154 Hz and the mean rise in F2 was 215 Hz; FACE vowels had a mean fall in F1 of 181 Hz and a mean rise in F2 of 331 Hz. Thus, preliminary results show that [X] resembles the PRICE vowels in the amount of its F1 and F2 movement.

Figure 3 shows, however, that the FACE vowels had a nucleus that originated from a similar F1/F2 starting point to [X] and that the finishing target offglide [ɪ] position was similar to [X] in all FACE tokens but only one of the PRICE tokens. Moreover, there were multiple PRICE token anomalies, such as the central-back *tonight.*

Discussion

The onset consonant in [X] might be [ɹ] as there is a low-starting, upward movement in F3 which is highly characteristic of the alveolar approximant in spectrograms (Kent and Read, 2002:180-181; Ladefoged, 2003:149-150). On the other hand, the police transcription of [X] as 'Mike' is harder to invalidate since the standard frequency range of a telephone (300 Hz to 3400 Hz) would cut out the signature low first formant of around 250 Hz that characterises nasal consonants (Ladefoged, 2006: 193).

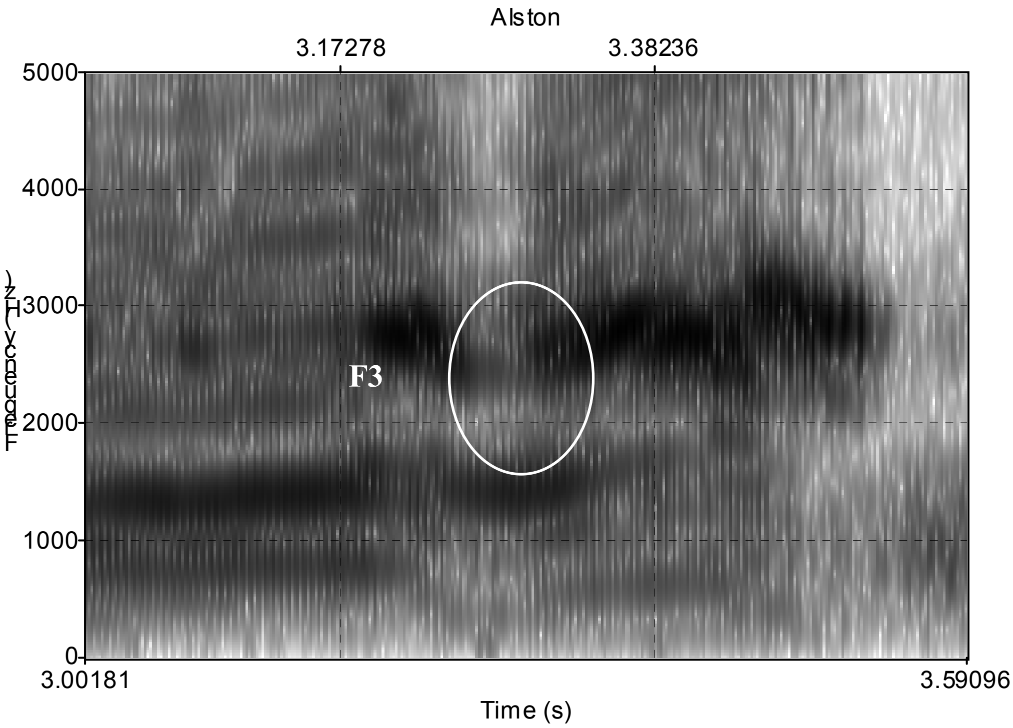

Figure 4: The low, upward moving F3 frequency in the spectrogram suggests this consonant may be [ɹ]

Both diphthongs showed a large amount of intra-speaker variation, particularly PRICE. Figure 3 shows that only 2 tokens (*tonight, right)* showed an expected rise toward [ɪ], which indicates a high degree of variability in Alston's PRICE movements. Previous research, such as McDougall (2006) and Hughes, McDougall and Foulkes (2009:5), has highlighted that within-speaker variation in diphthong articulation can occur due to connected speech processes and syllable context. The fact that *Alston.wav* is a series of telephone recordings of real speech and not laboratory-elicited words should also be noted.

Additionally, the effect of monophthongisation in PRICE vowels due to the suspect's possible Liverpudlian accent features may have also affected the results garnered. Watson (2007) details that PRICE vowels can become monophthongs in words such as 'time' (one of the tokens here) and 'five'. Indeed, this may have occurred with *time*, which shows little of the dynamic movement characteristic of a diphthong (Figure 5 demonstrates *time*'s flat F1 and F2 trajectory).

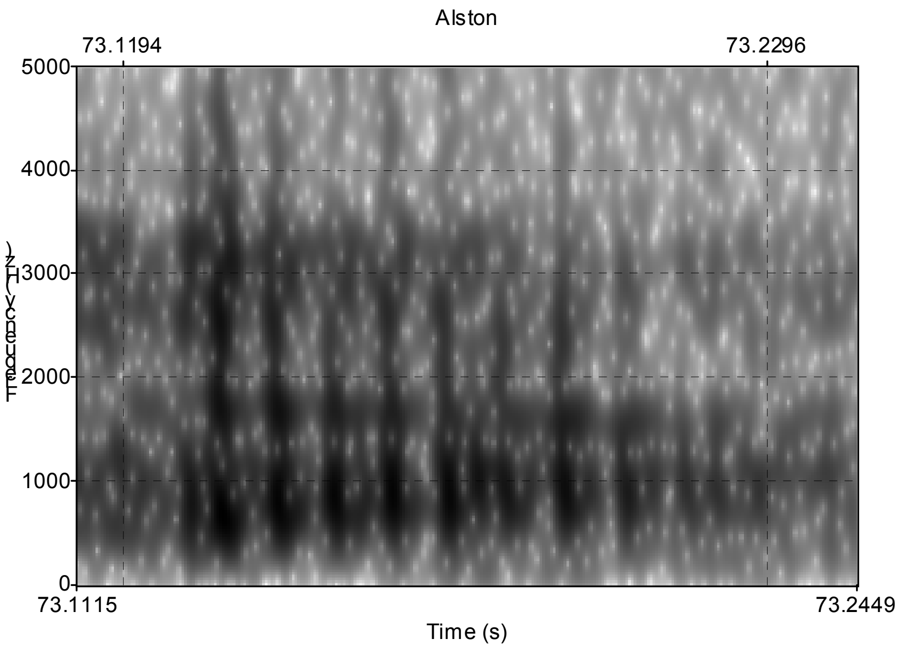

Figure 5: A spectrogram of the vowel in *time*

Conclusively, the questioned utterance [X] could be the name "Ray" rather than "Mike" based on the finding that the initial consonant resembles [ɹ] and due to the dynamic movement of the vowel, which resembles FACE tokens in the data. However, as there are too many outlier tokens of PRICE in Figure 3 and, overall, far too few tokens of either FACE or PRICE vowels by Alston in the recordings, this would be merely a suggestion and not a definitive conclusion.

<u>Word count (excluding all figures and captions)</u>: 1041

References

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