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A COMPARATIVE STUDY OF THE VOWEL SYSTEMS IN WEXFORD AND BELFAST ENGLISH

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ABSTRACT

This study compares the vowel systems of two regional varieties of Irish English—Wexford and Belfast—by integrating impressionistic and acoustic analyses. Guided by Daniel Jones's vowel-quadrilateral model, auditory transcriptions were plotted on IPA quadrilaterals to estimate tongue height and backness of the two varieties. Informed by Stevens's quantal theory, which links formant frequencies and duration to perceptual vowel identity, F1, F2, F3, and absolute relative vowel durations of the two systems were extracted with Praat. The findings demonstrate notable differences in the realization of back vowels and diphthongs, accompanied by distinct durational patterns, thereby validating the characterization of Wexford English as a prototypical Southern Irish English variety and affirming Belfast English as emblematic of Northern Irish English.

Keywords: Irish English Wexford English, Belfast English, impressionistic and acoustic analyses.

1. INTRODUCTION

As a widely used language in the world, English in Ireland could be traced back to 800 hundred years ago. Since English settlers invaded the isle at the end of twelfth century, Irish people, who had spoken Gaelic, started to adopt English and gradually abandoned their native language. In the nineteenth century, the majority of people became monolinguals of English for a multitude of factors, according to Raymond Hickey (2012). Nowadays, only a small number of people speak Irish. Despite the language shift, some unique phonetic features remain in the English spoken by Irishmen, which distinguish them from speakers of English in other places and become their iconic identity.

Generally speaking, the vowel system in Irish English is highly associated with the counterpart in Irish in a cluster of qualities, and some scholars (Bliss 1972a, 1979) pointed out that the system bears more similarities with that of Early Modern English. For example, compared to RP, no corresponding diphthongs like /ɪə, ɛə, ʊə/ could be found in Irish English. Short vowels usually amalgamate with /r/ to form a long rhotacized vowel [ɚː].

However, it should be noted that inhabitants in the island do not speak exactly the same variety of English due to the island is linguistically and politically divided into two parts, the north and the south. Different dialects are incorporated with features from different sources: features of Anglo-Irish, Scottish-type accent and indigenous Irish are introduced into the northern part of the island characterized by typical Ulster English, whereas the southern Irish English is considerably influenced by Gaelic, according to J. C. Wells (1982).

As for the northern accent, according to Corrigan (2010), [e] is pronounced for FACE vowel and /ɪ/ could have wider lip opening of varied degrees. Mid front vowel breaking and /u/ fronting

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are two key features, meaning that the vowel in SAVE is pronounced as [eːə] and BOOT vowel is realized as [bʉt]. /aʊ/ could be realized as different versions, with the first element realized as something ranging from [a] to [ɑ] and the second element from [i] to [ʉ], as Wells (1982) stated. As the capital in the north, Belfast English is a combination of traits of Ulster English and variants of Irish. Noticeably, J. C. Wells (1982) mentioned that PRICE vowel in Belfast could be realized as /eɪ/ and /e/might be realized as /ɛ/ or /eə/, and /ɛ, ɑ, ɔ /,tend to be fully open front or central. /u/ could be realized as /ʌ/ for working class and /ʌ/ could be centralized as [ɔ̈] or [ʌ̈] like in RP

As regards the southern accent where the vowel system resembles that of Irish (J.C. Wells, 1982), it is noticeable that /ɒ, ɔː/ are most pronounced as unrounded versions [ɑ, ɑː] and [ɑ] and [a] are seen as the allophones of the same phoneme, and Wells(1982) also showed that both PRICE and CHOICE vowels are realized as /ɒɪ/ instead of /ɔɪ/, Wexford, along with other towns along the east coast like Carlow and Dublin share the features of front onset of /au/, centralization of /ai/ and breaking of long high vowel (Hickey, 2004). The author would explore in detail to investigate whether these features comply with the speeches these days. To achieve this, seven parts are included to conduct the whole analysis. This section introduces the background information about Irish English and the layout of this essay followed by methods in section 2 and materials in the section 3. The following three parts showcase the results of the analysis, with section 4 and 5 presenting the detailed auditory and acoustic description of vowel systems in Wexford English and Belfast English respectively and section 6 conducting a comparison of the two vowel systems. Finally, all of these are brought to the end by section 7 providing a brief overview of the critical results with future directions stated.

2. METHODS

Both impressionistic and acoustic method are applied to conduct the study. Proposed by Daniel Jones (1917), the vowel quadrilateral is a theoretical model that maps tongue height, tongue backness, and lip rounding onto an abstract quadrilateral diagram. It serves as the IPA standard for visually representing vowel articulation, effectively translating auditory impressions into a spatial framework. So during the impressionistic analysis, the author listened to the audios of both varieties and plotted on the quadrilaterals to roughly determine the tongue position and lip rounding of each vowel.

Stevens (1989) points out that both formant frequencies and vowel duration jointly determine listeners' perceptual boundaries. Based on this insight, the study focuses on analyzing the formant structures and temporal characteristics of vowels in the two systems. According to Ladefoged and Johnson (2014), software tools such as Praat enable detailed acoustic analysis by displaying energy concentrations at specific frequencies as dark bands, thereby revealing the source and filter characteristics of speech.

In this study, Praat was used to measure vowel durations by segmenting the relevant portions of the spectrogram (as illustrated in Figure 2.1, "Segmentation for /i/"). Segment boundaries were primarily determined based on visual acoustic cues in the spectrogram, with auditory impressions serving as a supplementary reference. The first, second, and third formant frequencies, as well as vowel durations, were extracted, tabulated, and plotted to facilitate visual inspection and further analysis.

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Segmentation for /i/

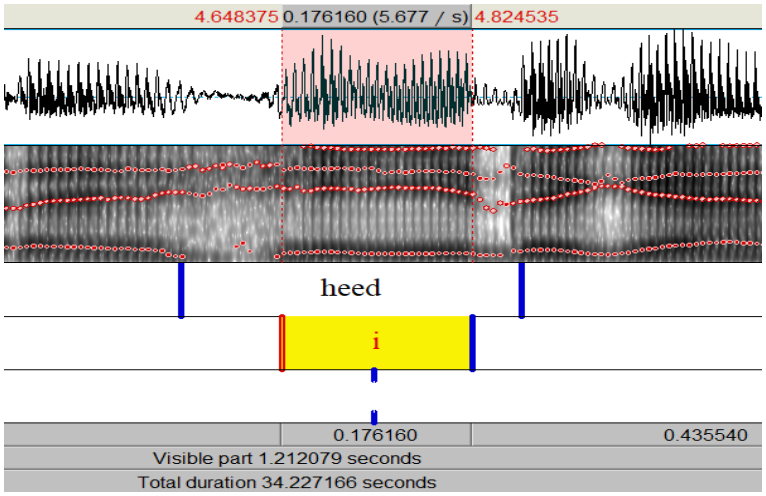


Figure 2.1 segmentation for vowel /i/ from 'heed' in Wexford English

3. MATERIALS

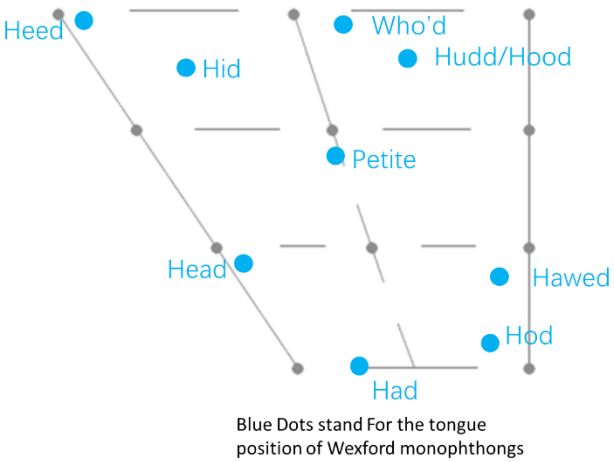
The audios used in the study were offered by two male informants in their 20s, one of whom is from Wexford and the other from Belfast. Both of them were required to read a list of short sentences 3 times and got recorded separately, that is, altogether 6 audio files were collected. All the vowels in both systems were elicited in the identical phonetic context [h_d] in carrier sentences 'Say _again'. The words included in the context were "heed, hid, hayed, head, had, hod, hawed, hoed, Hudd, hood, who'd, hide, hoyed, how'd, petite". In the spectrogram of each vowel, a set of F1, F2, F3 at a time-point were chosen for each monophthong whereas two sets of tokens at two time-points were selected for diphthongs, one time-point from the earlier part and the other from the later part.

4. RESULTS FOR WEXFORD ENGLISH

This section lays out the analysis of vowel qualities for Wexford monophthongs using auditory and acoustic methods in 4.1, the same goes to diphthongs in 4.2. what follows is 4.3, presenting the comparison of durations for long and short vowel pairs that bear similar vowel qualities, and finally comes the comment on the relationship between Wexford English and Southern typical English in respect of vowel systems in 4.5.

4.1 Wexford English: monophthongs

Figure 4.1.1 Wexford Monophthongs



Blue Dots stand For the tongue position of Wexford monophthongs

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As is illustrated in in Figure 4.1.1, according to auditory plotting on the quadrilateral, most monophthongs in the Wexford vowels system are realized somewhere near the cardinal vowels, except a few sounds. The most remarkable character is that WHO'D vowel is realized as much more advanced than cardinal vowel 8 even close to the central vowel /ʉ/, thus transcribed as /u̟/ and that both HOOD and HUDD vowels in are realized as the same sound, near back near close rounded, transcribed as [ʊ]. The vowel /æ/ in HAD is realized as /a̟/, near front open and retracted relative to cardinal the fourth cardinal. Schwa is also somewhat raised and could be transcribed as /ə̟/.

Following the acoustic method, we can get table 4.1.2 (see appendix), presenting the averages of three sets of values of the frequencies of the first three formants and based on this table, Charts 4.1.3 and 4.1.4 can be obtained, with the former displaying the general trend and relationship

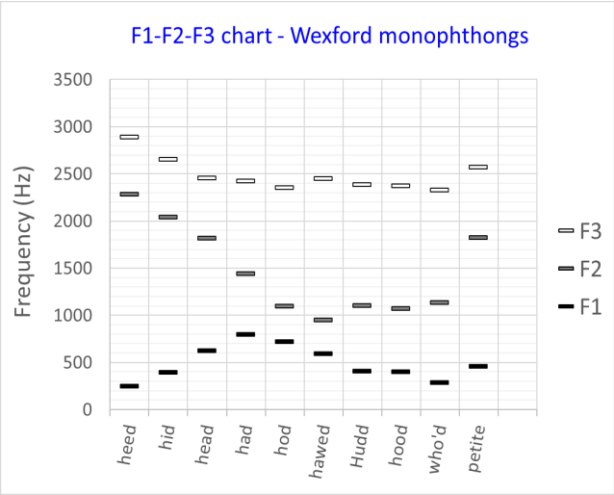


Chart 4.1.3 F1, F2, F3 are shown by the vertical axis and monphthongs by the horizontal axis.

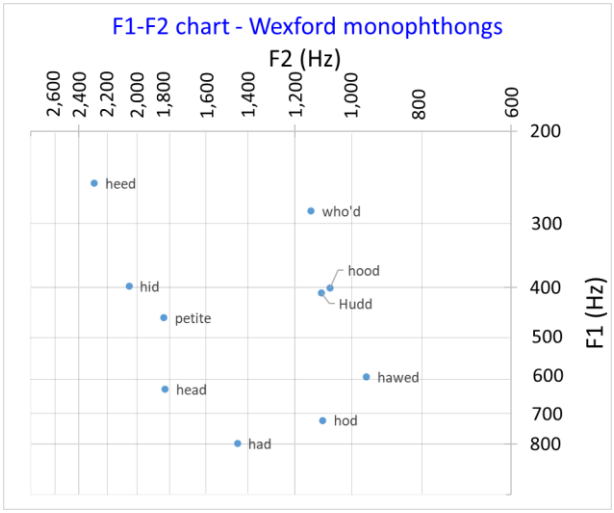
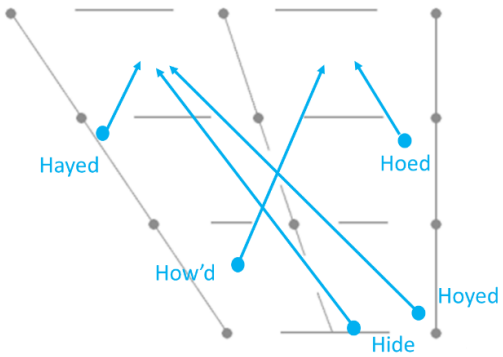


Chart 4.1.4 A formant chart showing the F1 on the vertical axis plotted against the F2 on the horizonal axis.

between each two neighbouring vowels and the latter corresponding to the auditory quadrilateral. All these figures and plots are roughly in accordance with the auditory impression above.

Chart 4.1.3 shows that F1 goes up steadily from HEED to HAD, but there is a larger jump in the frequency of the second formant between /ɛ/ and /æ/ compared with the one between /ɪ/ and /ɛ/, which explains the retraction of the tongue. The three formants of the HUDD vowel and HOOD vowel are nearly equal, with the frequencies of the former, F1(410Hz), F2 (1101Hz), and F3 (2386Hz) slightly higher than those of latter, F1 (401Hz), F2 (1101Hz) and F3 (1070Hz). As for WHO'D vowel, it demonstrates a F2 of 1139Hz, even higher than that of HUDD. All these are straightforward in the Chart 4.1.4,

Figure 4.2.1 Wexford Diphthongs



Blue dots represent the starting points while arrows indicate the direction and ending of Wexford Diphthongs

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in which HOOD is extremely close to HUDD and the F2 of schwa is 1827Hz, higher than that of HEAD vowel, 1817Hz, making it sound like an open vowel.

4.2 Wexford English: diphthongs

Applying impressionistic analysis, we can get Figure 4.2.1. it shows that the starting vowels of three diphthongs are realized relatively far from the corresponding cardinal vowels. HIDE diphthong in Wexford is realized as an open central unrounded vowel [ä], transcribed as [äɪ]. HOW'D vowel starts from a near front near open-mid unrounded vowel [a̋ʊ]. HOED vowel starts from a point next to cardinal vowel 7 [o] instead of the schwa, transcribed as [oʊ]. HAYED diphthong can be transcribed as [e̝ɪ], and HOYED diphthong as [ɒɪ].

Based on data collected using the acoustic method, we got two sets of averages of frequencies of three formants for each diphthong in Table 4.2.2 (see appendix), so the variations of frequencies within each diphthong and the general trend for all are vividly illustrated in Chart 4.2.3, which shows that the HIDE diphthong begins with a relatively low F2, 1167Hz and ends with a higher F2, 2179 Hz, thus demonstrating the sharpest surge among all the variations of F2.

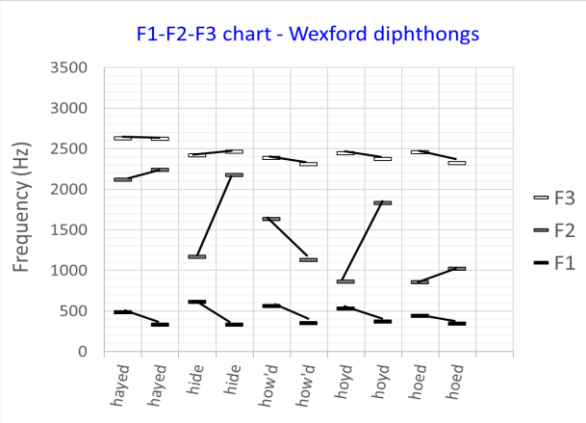

Chart 4.2.3 the initial point (left) and the end point (right) of each diphthong is joint with a black line (F1, F2, F3 are shown by the vertical axis and diphthongs by the horizontal axis).

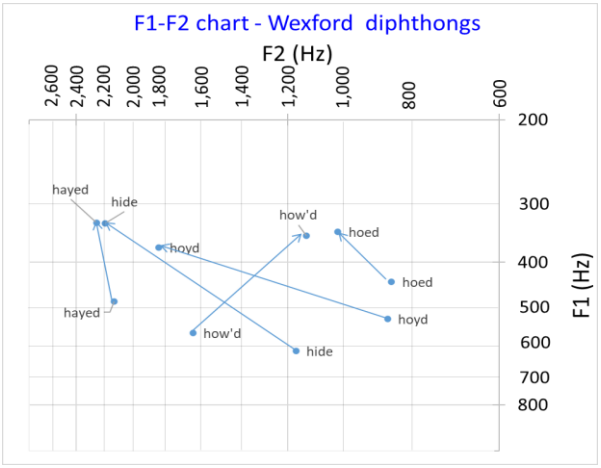

Chart 4.2.4 Lines with arrows are used to represent diphthongs gliding from the start to the end point.(F1 shown by ordinate and F2 by abscissa)

HOW'D is the only one vowel in which both F1 and F2 drop from the beginning points to the end points, from 564Hz to 351Hz for F1 and from 1636Hz to 1127Hz for F2. Chart 4.2.4 combines values of F1 and F2 of each diphthong and gets all the starting points and end points connected respectively in the for a comparison with the impressionistic quadrilateral. It reveals that nearly all the diphthongs are in compliance with the auditory quadrilateral. The starting point of HOED vowel shows a slightly lower frequency of F2 (854Hz) than that of HOYED (865Hz) and the first formants (440Hz and 527Hz) of the two do not vary too much. Moreover, the gap between F1 and F2 is much smaller than that between F2 and F3 at the beginning of HOED diphthong, which could also be evidence to deny the starting vowel as the schwa.

4.3 Durational differences between long and short pairs

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Table 4.3.1 and Table 4.3.2 (see appendix) present the durations of monophthongs and diphthongs respectively, which are correspondingly illustrated with two bar charts, Chart 4.3.3 and 4.3.4. For the duration of most monophthongs, the opener the vowel is, the longer duration it has except HEED, demonstrated by the increase in durations from HID (74ms) to HAWED (169ms). As for

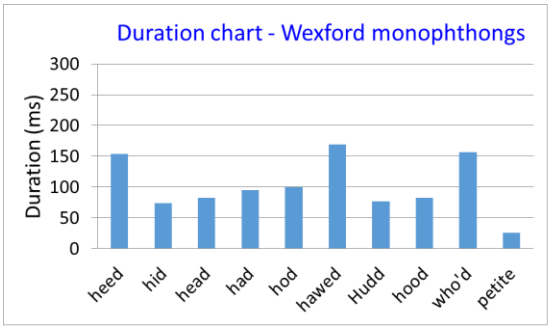

Chart 4.3.3 Durations are shown by the vertical axis and monophthongs by the horizontal axis.

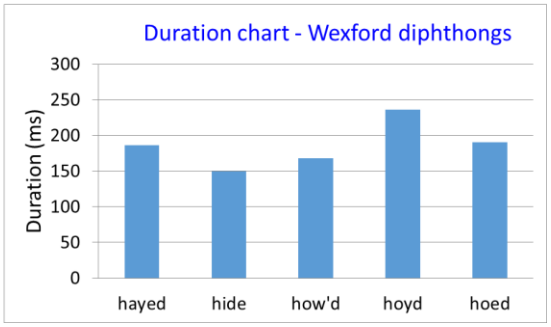

Chart 4.3.4 Durations are shown by the vertical axis and diphthongs by the horizontal axis.

diphthongs, all of the diphthongs are over 150ms long with HOYD lasting 236ms, much longer than the rest. HAYED vowel and HOED vowel are nearly equally long, 186Hz and 190Hz respectively, and HOW'D vowel (168ms) is just a little longer than HIDE vowel (150ms).

Table 4.3.5 shows the absolute values of paired vowels, each pair including a long vowel and a short one with similar tongue height, and their relative values, which are also demonstrated in bar charts Chart 4.3.6 and Chart 4.3.7 respectively. Table 4.3.5 shows that the duration ratios across the five long–short vowel pairs range from 1.69 to 2.47, indicating that long vowels are generally 1.7–2.5 times longer than their short counterparts, although the exact ratio varies markedly across vowel pairs. Three pairs demonstrate ratios over 2, with HOED-HUDD pair having a ratio of 2.47 and presenting the most striking gap between the opener vowel (190ms) and the closer vowel (77ms). Two pairs exhibit duration ratios between 1 and 2. HAWED-HOD display the lowest ratio of 1.69, with the former lasting 169ms and the latter 100ms and WHO'D-HOOD (157ms and 87ms respectively) pair demonstrate the ratio of 1.89.

Table 4.3.5 Long-short vowel duration ratio

V pair	duration ratio	V:	V
heed-hid	2.08	154	74
hayed-head	2.24	186	83
hawed-hod	1.69	169	100
hoed-Hudd	2.47	190	77
who'd-hood	1.89	157	83

4.4 The role of quality and duration

Given that most longer vowels have around twice the length of the short ones and the paired vowels show similar qualities, it should be admitted that in Wexford variety duration plays a major role in distinguishing the paired phonemes, especially in HEED-HID pair, WHO'D -HOOD pair and HAWED-HOD pair. These three pair are similar in lip rounding as well as tongue height but could be distinguishable, for /i/ in the first pair, /u/ in the second and /ɔ/ in the third are much longer than /ɪ/, /ʊ/ and /ɑ/. However, for the remaining pairs, vowel quality should be the main

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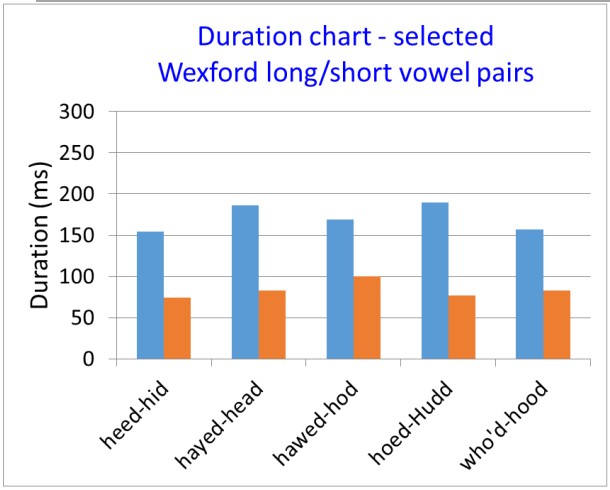

Chart 4.3.6 Duration values are shown by the vertical axis and vowel pairs by the horizontal axis.

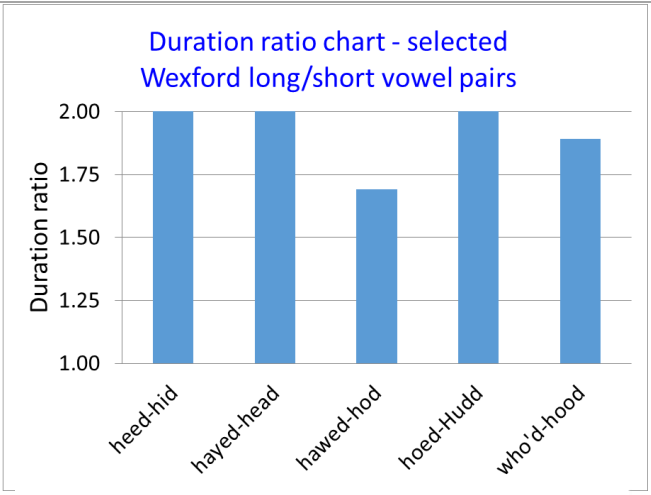

Chart 4.3.7 Duration ratios are shown by the vertical axis and vowel pairs by the horizontal axis.

evidence to make distinctions while duration just serves an auxiliary role, as the starting vowel of HOED and the ending vowel of HAYED are easily recognizable.

4.5 Wexford English: a typical Southern Irish English Variety?

Wexford English could be seen as a typical Southern Irish English. As is mentioned in the first section, most typical features are included: The /aɪ/ sound is realized as a centralized diphthong [äɪ] (John C Wells, 1982), HOD vowel and HAWED vowel are pronounced as the allophones of the /ɒ/, and HAD vowel is realized as [a̱].

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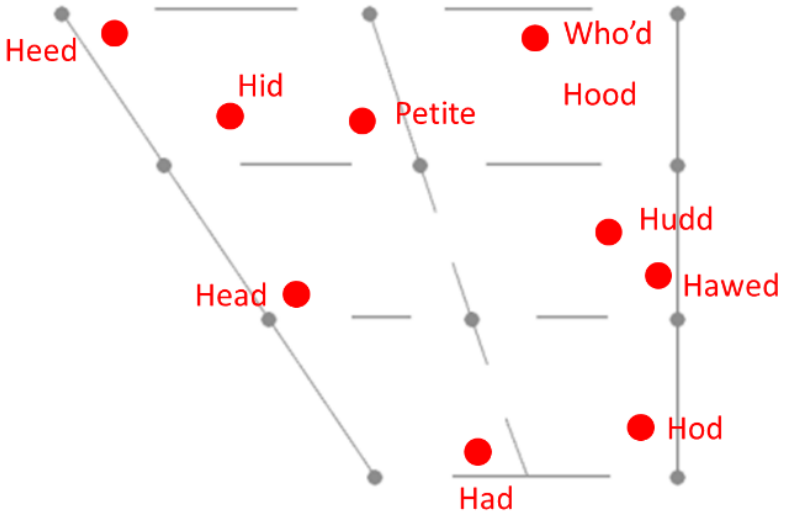
5. RESULTS FOR BELFAST ENGLISH

As with the layout of section 4, this section first presents the analysis of vowel qualities for Belfast monophthongs applying auditory and acoustic methods in 5.1, followed by the exploration of diphthongs using the two methods in 5.2. Then there comes 5.3 on the durational differences for paired vowels with similar tongue height. Section 5.4 explains the role of quality and duration in Belfast vowel system and finally the conclusion will be arrived at on the typicality of Belfast English as Northern Irish English in 5.5.

Figure 5.1.1 Belfast Monophthongs



Red dots stand For the tongue position of Belfast monophthongs

5.1 Belfast English: monophthongs

As is demonstrated in Figure 5.1.1, Belfast front vowels are realized as similar to those of Wexford while there exist bigger differences among back vowels and schwa. /ɛ/ is slightly closer and backer relative to cardinal vowel 3, transcribed as [ɛ̟]. Schwa is significantly raised and a little advanced, labelled as [ə̟]. Both /ɔ/ and /ʌ/ vowel are advanced and raised near cardinal 6 but vary in degree, with the former transcribed as [ɔ̝], counterpart. WHO'D vowel is much advanced and slightly lowered relative to [u], transcribed as [u̟] relative to cardinal vowel 8. The remaining vowels are roughly the same as the Wexford ones.

By means of the acoustic method, we can get Table 5.1.2 (see appendix), presenting the averages of three sets of values of the frequencies of the first three formants and based on this table, Charts 5.1.3 and 5.1.4 can be obtained, with the former displaying the general trend and relationship

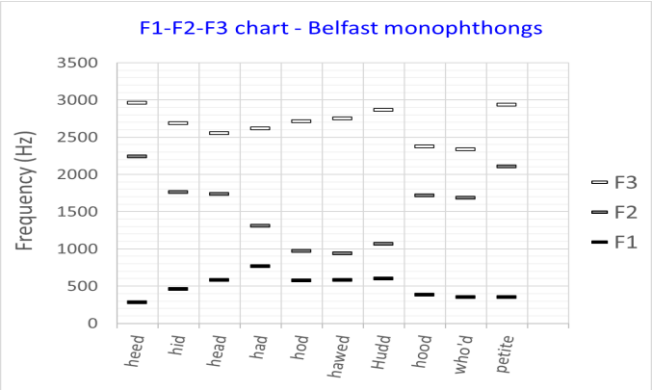


Chart 5.1.3 F1, F2, F3 are shown by the vertical axis and monphthongs by the horizontal axis.

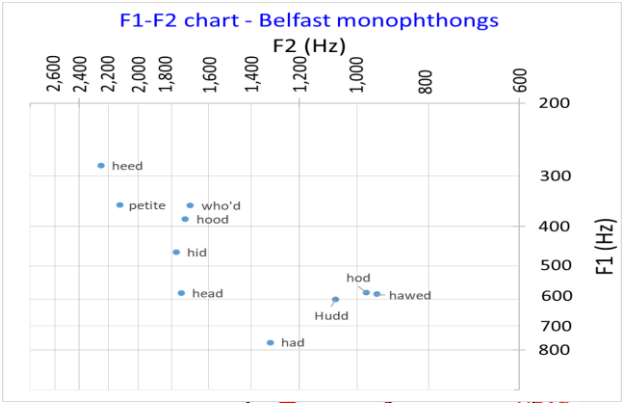


Chart 5.1.4 A formant chart showing the F1 on the vertical axi s plotted against the F2 on the horizonal axis.

while arrows indicate the direction and ending of Wexford Diphthongs

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between each two neighbouring vowels and the latter corresponding to the auditory quadrilateral. From these table and figures, we can see that schwa and some back vowels are fronted in Chart 5.1.4. HAWED vowel and HOD vowel have roughly equal F1(580Hz, 584Hz), F2 (971Hz, 939Hz) and F3 (2717, 2752Hz) and the formants of HUDD vowel (F1, 602 Hz, F2, 1069 Hz and F3, 2866Hz) are just a little higher than the two sounds, thus the first two are close in Chart 5.1.4 and the HUDD vowel is somewhat fronter and lower. /u/ and /ʊ/ are close neighbours in Chart 5.1.4 too because they present extremely close parameters, with the formants of latter (F1, 356 Hz, F2, 1690 Hz and F3, 2339Hz) slightly lower than those of the former (F1, 384 Hz, F2, 1718 Hz and F3, 2380Hz) and they are much fronted. The schwa sound has an extremely high F2, 2110Hz, ranking second, just below the F2 of HEED vowel, 2240Hz, so it is also considerably fronted even close to HEED vowel.

5.2 Belfast English: diphthongs

As Figure 5.2.1 shows, four diphthongs in HAYED, HOW'D, HIDE, and HOYD glide to the same area where [ɪ] situates but from different starting points, with the first from somewhere below cardinal vowel 2, the second from centralized [a], the third from a sound much fronter than [ɑ] and the last from somewhere near cardinal vowel 6, transcribed as [ɛ̟ɪ], [äɪ], [ɑ̟ɪ] and [ɔ̟ɪ] respectively. HOED diphthong is realized as [o̟ʊ].

As per the acoustic method**,** Table 5.2.2 (see appendix) shows all sets of averages of frequencies of three formants for each diphthong, and Chart 5.2.3 presents the variations of

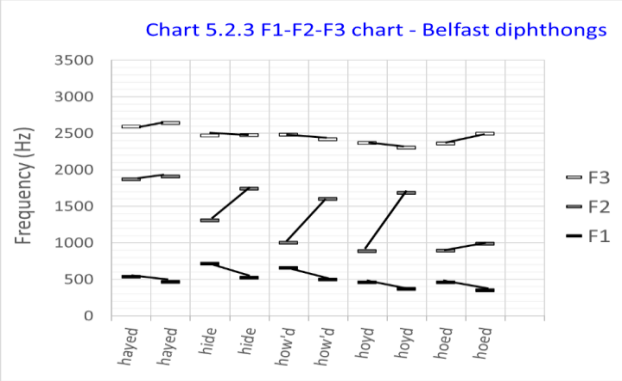

Chart 5.2.3 The initial point (left) and the end point (right) of each diphthong is joint with a black line (F1, F2, F3 are shown by the vertical axis and diphthongs by the horizontal axis).

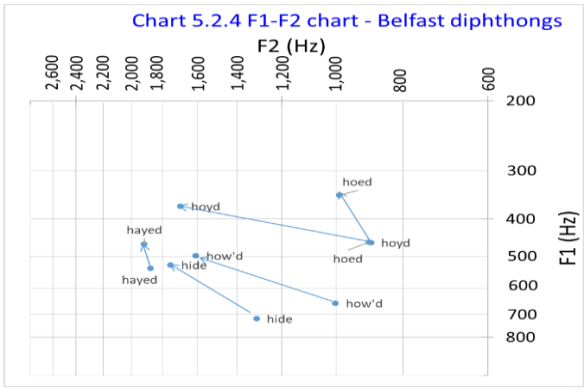

Chart 5.2.4 Lines with arrows are used to represent diphthongs gliding from the start to the end point.(F1 shown by ordinate and F2 by abscissa)

frequencies within each diphthong and the general trend for all. Using F1 and F2 of each diphthong, the starting point and end point are plotted and connected respectively in the Chart 5.2.4 for comparing with the auditory quadrilateral.

Chart 5.2.3 indicates that all the diphthongs experience an increase in F2 and drop in F1 within themselves. Hayed vowel and HOED vowel experience the least variations in both F1 and F2 throughout the process of articulation, whereas HIDE HOW'D and HOYD experience sharp increase in F2. Chart 5.2.4 illustrates that most diphthongs are generally in accordance with the auditory quadrilateral except in HOYD and HAYED. The diphthong /ɔɪ/ almost shares the same initial vowel with HOED, with the former having a F1 of 459Hz and F2 of 888Hz and the latter having a F1 of 458Hz and F2 of 895Hz. The end point of HAYED vowel is much fronted, with

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464Hz for F1 and 1907Hz for F2. It also shows that the end points of HIDE vowel and HOW'D vowel are obviously lower than that of HOYED because the former two have a comparatively higher first formants 524Hz and 496Hz respectively.

5.3 Durational differences between long and short pairs

Table 5.3.1 and Table 5.3.2 (see appendix) present the durations of Belfast monophthongs and diphthongs respectively, which are correspondingly illustrated with two bar charts, Chart 5.3.3 and Chart 5.3.4.

In terms of monophthong durations, Chart 5.3.3 shows that opener vowels tend to have longer durations except the vowel in WHO'D (148ms). Vowels in HEAD (172ms), HAD (142ms), HOD

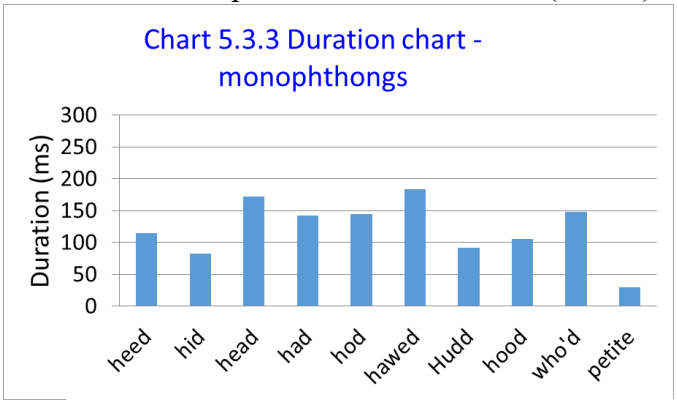

Chart 5.3.3 Durations are shown by the vertical axis and monophthongs by the horizontal axis.

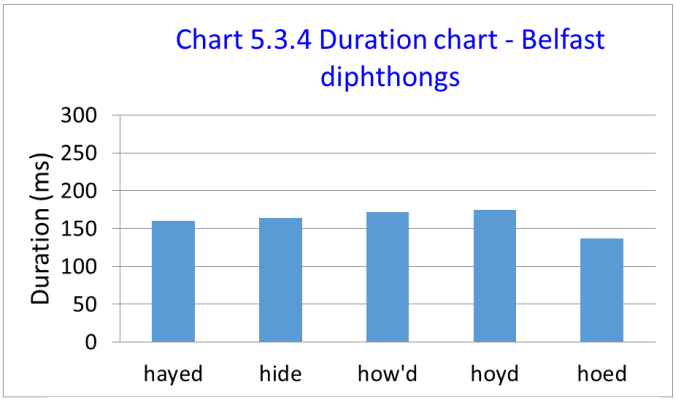

Chart 5.3.4 Durations are shown by the vertical axis and diphthongs by the horizontal axis.

(145ms), and HAWED (184ms) are longer than those in HEED (114ms), HID (82ms) HUDD (91ms) and HOOD (105ms). Table 5.3.2 and Chart 5.3.4 indicate that there is no big variation among the durations for diphthongs, all of their durations are over 160ms with HOED vowel lasting only 137ms. Table 5.3.5 presents the absolute values of paired vowels, each pair including a long vowel and a short one with similar tongue height, and their relative values, which are also demonstrated in bar charts Chart 5.3.6 and Chart 5.3.7 respectively.

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As Chart 5.3.6, as well as formant frequency tables (see appendix, table for all Belfast vowel formants) shows, not all opener vowels have a longer duration but on the contrary, higher vowels tend to be longer, which could be proven by the fact that /i/ (F1, 284Hz), /u/ (F1,356Hz) and /eɪ/ (F1, 533Hz) in HEED, WHO'D and HAYED are longer than /ɪ/ (F1, 462Hz) in HID, /ʊ/ (F1, 384Hz) in HOOD, and /e/ (F1, 581Hz) in HEAD. It also demonstrates that longer vowels are just several decades milliseconds longer than the short one. Even the biggest length gap is only 46ms displayed by HOED-HUDD pair.

Chart 5.3.7 along with Table 5.3.5 shows that these ratios witness no great variations, ranging from 0.93 (HEAED-HEAD pair) to 1.51 (HOED-HUDD pair), meaning no striking difference between higher and lower vowel length within each pair. HEED-HID pair and HAWED-HOD pair have the equal ratio 1.27, meaning that longer vowels are just a little longer than the shorter one, for most ratios are just somewhat above 1.

5.4 The role of quality and duration

As is illustrated in the bar charts, those paired vowels do not display very obvious differences in duration which can be evidenced by the duration ratios ranging from 0.93 to 1.51. Thus, Belfast vowels mainly count on vowel quality to distinguish similar vowels with duration as a complementary method for decision making.

Table 5.3.5 Long-short vowel duration ratios

V pair	duration ratio	V:	V
heed-hid	1.27	114	82
hayed-head	0.93	160	172
hawed-hod	1.27	184	145
hoed-Hudd	1.51	137	91
who'd-hood	1.41	148	105

5.5 Belfast English: a typical Northern Irish English Variety?

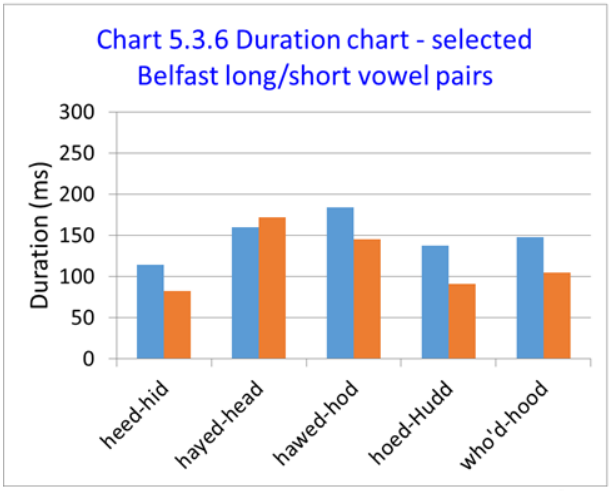

Chart 5.3.6 Duration values are shown by the vertical axis and vowel pairs by the horizontal axis.

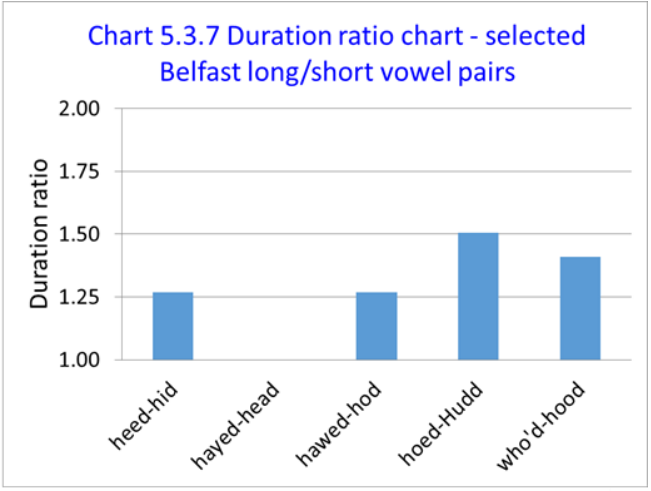

Chart 5.3.7 Duration ratios are shown by the vertical axis and vowel pairs by the horizontal axis.

According to both acoustic and auditory analysis, it is reasonable to judge Belfast English as a typical Northern Irish Variety, for it embodies many representative northern traits such as the

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well-known realization of /aʊ/ in HOW'D resembling [aɪ]. Besides, both /a/ and /ɛ/ are somewhat neutralized as in HAD and HEAD respectively and /u/ is closer and central in WHO'D, as Wells (1882) mentioned. Also, /ʌ/ in HUDD is a little fronted relative to cardinal vowel 6, though whether lip rounding is added is confusing.

5.6 A Comparison of the Two Vowels Systems

Phonetically, Wexford and Belfast vowel systems have much in common in front vowels but differ a lot in the back vowels and schwa in respect of monophthongs. Only HID vowel in Belfast is realized somewhat retracted and lower relative to the Wexford one. Two back vowels in Belfast are realized fronter than their counterparts in Wexford. WHO'D and HOOD vowels in Belfast, as Hickey (2012) agreed, are much front and close, whereas HOD vowel is backer and closer, and HUDD is opener. In terms of diphthongs, the end points of some Belfast diphthongs are somewhat more retracted than the corresponding Wexford variants. The most striking difference is the realization of HOW'D vowels. HOW'D vowel in Wexford starts from a near front, near open vowel [a̟] to [ʊ] while the Belfast version glides from a back, near open vowel to somewhere centralized [e] or [ɪ] for some, thus transcribed as [ɑɪ], which roughly agrees with the of J. C. Wells's (1982) description. Also, /eɪ/ in Belfast is realized as rather like a long monophthong /ɛː/, with the end point much lower than /ɪ/ in Wexford. The two varieties demonstrate no salient difference in distinguish vowel phonemes in phonology despite that Wexford Vowel system depends more on durations to distinguish paired sounds with similar tongue height while Belfast relies more on qualities.

6. CONCLUSIONS

To summarize, prominent differences of Wexford and Belfast vowel systems mainly exist in back vowels and in the starting points of diphthongs. /u/ and /ʊ/ in Belfast vowel system are much fronter and closer than their allophones in Wexford vowel system. Belfast /ɑ/ is backer and closer, and HUDD is opener. Also, /aʊ/ in Belfast ends with a front vowel while its Wexford version ends with a back vowel and other diphthongs in Belfast have relatively lower end points. Schwa sound in Belfast is much higher and slightly fronter while in Wexford it is just raised. Interestingly, some features occur in both accents investigated in this paper while some never appear in either system. For example, the WHO'D vowel is fronted and the short front high vowel /ɪ/ is lowered in both accents. On the other hand, the diphthong /aɪ/ presents no obvious sign of being realized as /æɪ/ or /eɪ/ in both varieties. Moreover, the habits of breaking /e/ into /eə/ and pronouncing /eɪ/ into [eːə] are missing in both varieties. As Corrigan (2010) implied, Characters of this kind might be variable due to factors like supraregional process or informants' religious belief etc.

However, there are some defects in the research. Firstly, lip rounding could hardly be judged especially when merely using auditory analysis. Secondly, the background information of participants is limited for their specific areas are unknown, as accents in Belfast may vary from region to region, from gender to gender and from career to career etc. Therefore, more detailed information about the informants could be collected and the range of participants could be expanded for further investigate features of the two vowel systems. Moreover, more complicated carrier contexts that possibly impact the articulation of vowels could be taken into account.

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Appendix

All formants and durations of Wexford

Vowel	F1	F2	F3	duration
heed	256	2197	2777	176
heed	248	2404	3189	139
heed	251	2251	2701	147
heed	**252**	**2284**	**2889**	**154**
hid	401	2025	2689	89
hid	401	2081	2631	72
hid	391	2014	2641	60
hid	**398**	**2040**	**2654**	**74**
hayed	508	2113	2666	201
hayed	497	2087	2655	179
hayed	447	2149	2562	177
hayed	**484**	**2116**	**2628**	**186**
head	637	1769	2397	84
head	590	1881	2439	88
head	657	1801	2542	78
head	**628**	**1817**	**2459**	**83**
had	813	1449	2411	102
had	803	1485	2392	90
had	777	1392	2475	94
had	**798**	**1442**	**2426**	**95**
hod	713	1113	2438	105
hod	719	1078	2361	100
hod	729	1099	2269	94
hod	**720**	**1097**	**2356**	**100**
hawed	545	903	2573	194
hawed	616	971	2431	160
hawed	622	985	2342	153
hawed	**594**	**953**	**2449**	**169**
hoed	424	814	2524	192
hoed	418	828	2461	185
hoed	479	920	2391	194
hoed	**440**	**854**	**2459**	**190**
Hudd	408	1124	2424	81
Hudd	402	1020	2378	86
Hudd	419	1160	2356	64
Hudd	**410**	**1101**	**2386**	**77**
hood	389	1094	2446	86
hood	394	1025	2386	87
hood	419	1092	2287	75
hood	**401**	**1070**	**2373**	**83**

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who'd	290	1170	2414	171
who'd	278	1118	2325	157
who'd	286	1129	2255	144
who'd	**285**	**1139**	**2331**	**157**
hide	574	1130	2377	145
hide	652	1158	2409	149
hide	619	1212	2476	156
hide	**615**	**1167**	**2421**	**150**
hoyed	503	810	2468	283
hoyed	527	886	2398	186
hoyed	550	898	2468	240
hoyed	**527**	**865**	**2445**	**236**
how'd	556	1736	2406	168
how'd	639	1731	2405	154
how'd	496	1441	2345	183
how'd	**564**	**1636**	**2385**	**168**
petite	363	1765	2547	28
petite	756	1788	2620	22
petite	252	1928	2544	27
petite	**457**	**1827**	**2570**	**26**
Second time-point for diphthongs				
hayed	328	2192	2705	201
hayed	327	2229	2571	179
hayed	336	2304	2601	177
hayed	330	2242	2626	186
hoed	378	1042	2310	192
hoed	328	947	2290	185
hoed	328	1066	2371	194
hoed	345	1018	2324	190
hide	351	2115	2282	145
hide	319	2270	2495	149
hide	324	2152	2616	156
hide	331	2179	2464	150
hoyed	343	1959	2416	283
hoyed	422	1594	2343	186
hoyed	352	1935	2356	240

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hoyed	372	1829	2372	236
how'd	363	1155	2269	168
how'd	363	1123	2345	154
how'd	328	1104	2312	183
how'd	351	1127	2309	168

Table 4.1.2 Vowels and formant peaks of Wexford monophthongs

Vowel	F1	F2	F3
heed	284 Hz	2240 Hz	2965 Hz
hid	462 Hz	1767 Hz	2687 Hz
head	581 Hz	1740 Hz	2556 Hz
had	767 Hz	1314 Hz	2620 Hz
hod	580 Hz	971 Hz	2717 Hz
hawed	584 Hz	939 Hz	2752 Hz
Hudd	602 Hz	1069 Hz	2866 Hz
hood	384 Hz	1718 Hz	2380 Hz
who'd	356 Hz	1690 Hz	2339 Hz
petite	354 Hz	2110 Hz	2940 Hz

Table 4.2.2 Vowels and formant peaks

Of Wexford diphthongs

Vowel	F1	F2	F3
hayed	484 Hz	2116 Hz	2628 Hz
hayed	330 Hz	2242 Hz	2626 Hz
hide	615 Hz	1167 Hz	2421 Hz
hide	331 Hz	2179 Hz	2464 Hz
how'd	564 Hz	1636 Hz	2385 Hz
how'd	351 Hz	1127 Hz	2309 Hz
hoyd	527 Hz	865 Hz	2445 Hz
hoyd	372 Hz	1829 Hz	2372 Hz
hoed	440 Hz	854 Hz	2459 Hz
hoed	345 Hz	1018 Hz	2324 Hz

Table 4.3.1 Durations of Wexford monophthongs

Vowel	Duration
heed	154
hid	74
head	83
had	95
hod	100
hawed	169
Hudd	77
hood	83
who'd	157
petite	26

Table 4.3.2 Durations of Wexford diphthongs

Vowel	Duration
hayed	186
hide	150
how'd	168
hoyd	236
hoed	190

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All formants and durations of Belfast vowels

Vowel	F1	F2	F3	duration
heed	293	2260	2842	72
heed	303	2298	3103	138
heed	256	2163	2951	131
heed	**284**	**2240**	**2965**	**114**
hid	559	1660	2492	48
hid	446	1764	2845	79
hid	479	1769	2529	84
hid	**463**	**1767**	**2687**	**82**
hayed	554	1785	2414	138
hayed	509	1933	2644	165
hayed	537	1883	2713	176
hayed	**533**	**1867**	**2590**	**160**
head	580	1723	2525	150
head	573	1716	2491	166
head	590	1780	2652	199
head	**581**	**1740**	**2556**	**172**
had	753	1332	2569	138
had	768	1343	2666	144
had	781	1266	2626	144
had	**767**	**1314**	**2620**	**142**
hod	582	991	2514	141
hod	552	957	2795	143
hod	606	965	2841	150
hod	**580**	**971**	**2717**	**145**
hawed	589	987	2571	186
hawed	556	903	2873	183
hawed	609	928	2813	182
hawed	**585**	**939**	**2752**	**184**
hoed	415	881	2392	132
hoed	434	965	2397	140
hoed	526	839	2299	139
hoed	**458**	**895**	**2363**	**137**
Hudd	600	1098	2644	83
Hudd	590	1052	2891	109
Hudd	618	1057	3062	82
Hudd	**603**	**1069**	**2866**	**91**
hood	393	1704	2504	115
hood	399	1755	2380	83
hood	360	1694	2256	117
hood	**384**	**1718**	**2380**	**105**

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who'd	354	1706	2297	152
who'd	372	1681	2423	159
who'd	341	1684	2296	133
who'd	**356**	**1690**	**2339**	**148**
hide	705	1381	2495	173
hide	728	1245	2510	175
hide	717	1291	2402	145
hide	**717**	**1306**	**2469**	**164**
hoyd	489	873	2480	213
hoyd	457	916	2394	141
hoyd	432	876	2237	170
hoyd	**459**	**888**	**2370**	**175**
how'd	682	1017	2047	169
how'd	627	963	2693	199
how'd	656	1024	2713	149
how'd	**655**	**1001**	**2484**	**172**
petite	368	2393	3231	30
petite	350	2208	3264	27
petite	345	1730	2325	29
petite	**354**	**2110**	**2940**	**29**
Second time-point of Belfast diphthongs				
hayed	422	1874	2448	138
hayed	544	1768	2618	186
hayed	425	2080	2860	179
hayed	464	1907	2642	160
hoed	316	1002	2498	132
hoed	382	984	2747	140
hoed	346	980	2232	145
hoed	348	989	2492	137
hide	494	1746	2364	197
hide	514	1747	2667	189
hide	565	1740	2399	195
hide	524	1744	2477	164
hoyd	305	1836	2334	231
hoyd	403	1566	2210	141
hoyd	407	1655	2367	201

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hoyd	372	1686	2304	175
how'd	504	1564	2549	189
how'd	446	1798	2449	204
how'd	537	1442	2248	162
how'd	496	1601	2415	172

Table 5.1.2 Vowels and formant peaks of Belfast monophthongs

Vowel	F1	F2	F3
heed	284 Hz	2240 Hz	2965 Hz
hid	462 Hz	1767 Hz	2687 Hz
head	581 Hz	1740 Hz	2556 Hz
had	767 Hz	1314 Hz	2620 Hz
hod	580 Hz	971 Hz	2717 Hz
hawed	584 Hz	939 Hz	2752 Hz
Hudd	602 Hz	1069 Hz	2866 Hz
hood	384 Hz	1718 Hz	2380 Hz
who'd	356 Hz	1690 Hz	2339 Hz
petite	354 Hz	2110 Hz	2940 Hz

Table 5.2.2 Vowels and formant peaks Of Belfast diphthongs

Vowel	F1	F2	F3
hayed	533 Hz	1867 Hz	2590 Hz
hayed	464 Hz	1907 Hz	2642 Hz
hide	717 Hz	1306 Hz	2469 Hz
hide	524 Hz	1744 Hz	2477 Hz
how'd	655 Hz	1001 Hz	2484 Hz
how'd	496 Hz	1601 Hz	2415 Hz
hoyd	459 Hz	888 Hz	2370 Hz
hoyd	372 Hz	1686 Hz	2304 Hz
hoed	458 Hz	895 Hz	2363 Hz
hoed	348 Hz	989 Hz	2492 Hz

Table 5.3.1 Durations of Wexford monophthongs

Vowel	Duration
heed	114
hid	82
head	172
had	142
hod	145
hawed	184
Hudd	91
hood	105
who'd	148
petite	29

Table 5.3.2 Durations of Belfast diphthongs

Vowel	Duration
hayed	160
hide	164
how'd	172
hoyd	175
hoed	137