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| RESEARCH ARTICLE

An Acoustic Analysis of Six English Monophthongs Produced by Undergraduate Cameroonian ESL Learners

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| ABSTRACT
This study aims at studying the duration and the formants of the monophthongs /i/, /ɪ/, /a/, /æ/, /ɔ/ and /ɒ/ in the production of 19 undergraduate Cameroonian ESL (CamESL) students. The sounds put in *hvd* environment were read by the students in a calm environment, recorded and analysed using PRAAT version 6.1.16. The analysis of duration revealed that the students clearly distinguished between long and short vowels, but the study of the formants of the sounds indicated that no major distinction was made between the sound pairs, therefore resulting in the partial merger. The plot of the vowels also revealed a significant within-gender dispersion. It can therefore be concluded that CamESL learners' productions were characterised by partial merger, inaccurate tongue advancement and within-gender dispersion.

| KEYWORDS
Duration, formants, monophthongs, Cameroonian ESL learners, partial merger, inaccurate tongue advancement, within-gender dispersion

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1. Introduction

This article sets out to study the vowels /i/, /ɪ/, /a/, /æ/, /ɔ/ and /ɒ/ produced by CamESL learners by analysing by bringing out their duration and formants using acoustic analysis. The study is motivated by the fact that nowadays, there is a growing trend in the use of acoustic analysis in studying English spoken by L2 and EFL speakers, as the integration of New Technologies (NTs) into speech research offers numerous options and advantages in the analyses of the spoken corpus. Many English speech researchers used the acoustic method in their studies (Khalil, 2014; Ata, 2015; Atanda et al., 2017; Kirkham & Nance, 2017; Widagsa & Yuwono Putro, 2017; Bello et al., 2020; Abbo, 2021). These studies brought out the duration and formants of the vowel sounds, which constitute numerical data representing the features of the English produced by various English speech communities and the data can be used for diachronic and cross-dialectal studies (Abbo, 2021). Furthermore, the acoustic analysis appears to be an indispensable procedure in sociophonetic studies, given its capacity to bring out features that a listen-and-transcribe method cannot identify. Therefore, the best method of studying English sounds is by making acoustic analyses of the productions of a group of speakers (Ladefoged & Johnson, 2011), a method which is considered by Calamai (2005) as "unbiased and rapid" (p. 211). Hence, the main goal of this study is to bring out the duration and formants of six vowels produced by undergraduate CamESL students, along with the characteristic features of their productions.

2. Literature Review

Acoustic analyses have been used to study various aspects of the speech L1 and L2 as well as EFL speakers. This review presents some works on the acoustics of the vowels of BrE and AmE on the one hand and that of the vowels produced by Nigerian and Cameroonian speakers on the other hand. The review also looks at features of the vowels produced by Cameroonian ESL speakers from previous impressionistic studies.

2.1 The acoustics of the vowels of BrE and AmE

As far as BrE is concerned, the acoustic of the twelve vowels was studied by Wells in 1962. The researcher investigated the duration and the formants F1, F2 and F3 of BrE. These features constituted the identity of BrE, and the formants were used by the author to plot each vowel to its specific position. The features of BrE monophthongs from Wells' study are summarised in Table 1 below.

Table 1: Summary of monophthongs' features adapted from Wells (1962)

Vowels	/i/	/ɪ/	/ɛ/	/æ/	/ɑ:/	/ɒ/	/ɔ/	/ʊ/	/u/	/ʌ/	/ɜ/
Dur.	293	139	170	210	335	178	330	142	294	148	309
F1	285	256	569	748	677	599	449	376	309	722	581
F2	2373	2098	1965	1746	1083	891	737	950	939	1236	1381
F3	3088	2696	2636	2460	2340	2605	2635	2440	2320	2537	2436

Another study of the acoustic of BrE vowels was conducted by Henton (1983). A comparison of the results obtained by Henton and those from Wells (1962) revealed that the features of almost all the vowels had undergone a slight change which proves that the language has evolved over time (Henton, 1983, p. 354). The most significant cases of change from the study include the F1 of the vowels /ʌ/ and /ɜ:/, and the F2 of the vowels /æ/, /a**/**, /ʊ/ and /u/, have also changed (Henton, 1983, p. 354).

Other major works on the acoustics of BrE include Deterding (1997), who analysed the formants of Standard Southern British English (SSBE) from the MARSEC data base where words in citation form are compared with those from words in connected speech, Hawkings and Midgley (2005) who also discovered that the frequencies of the vowels vary with age group, Ferragne and Pellegrino (2010), and Bjelakovic (2016). The magnitude of the changes that the English language has undergone over time has led Wells (2001) and Lindsey (2014), as cited by Bjelakovic (2016), to think of a possible modification of the phonetic symbols that are used to represent RP nucleus in some words. The new symbols were estimated to provide a more faithful description of the real pronunciation of modern RP (See Bjelakovic, 2016, pp. 14-15).

As for AmE, the acoustics of the monophthongs from each of the wide varieties have also been studied by many researchers (Clopper et al., 2005; Adams, 2009; Koffi, 2013; Lee et al., 2014; Strelluf, 2014; Nikolić, 2015). One of the varieties was studied by Hillenbrand et al. (1995). The data for the study was collected from speakers from Michigan's Lower Peninsula, Illinois, Wisconsin, Minnesota, northern Ohio, and northern Indiana, with the aim of replicating and extending the classic study of vowel acoustics by Peterson and Barney (1952) as cited by Hillenbrand et al. (1995). The results of the analyses of the duration and formants (F1 to F4) of the vowels /i, ɪ, e, ɛ, æ, a, ɔ, o, u, ʊ, ʌ, ɜ/ in *hvd* frame also indicated a clear evolution of the English language as with the BrE variety.

A similar study was carried out by Clopper et al. (2005) on six regional dialects, namely New England, Mid-Atlantic, North, Midland, South and West. The study revealed that Westerners' speech was characterised by a merger in the production of the sounds /ɑ/ and /ɔ/ and /u/ from male speakers while Midlands' and Southerners' male speakers produced the /ɛ/ whereas female speakers produced it as /e/. It can be concluded that merger is a widespread linguistic phenomenon which is present in the productions of many speech communities.

Another acoustic study was carried out on the acoustics of African-American speakers. The acoustic study of this variety of English was carried out by Adams (2009) from four males and four females aged between twenty-two and twenty-three, all eight residing in Michigan. It was also discovered that in NCS, "the tense vowels [i] and [e] are longer than the lax vowels [ɪ , ɛ] by an average of 20 ms" and "tense vowels were also seen to be shorter than the lax vowels by an average of 6 ms" (P. 43). Many other studies confirmed the existence of the merger phenomenon in AmE (Wells, 1982; Koffi, 2013; Strelluf, 2014).

2.2 The acoustics of vowels from Nigerian and Cameroonian speakers

Acoustic studies of English vowels from Nigerian speakers have been the interest of many researchers (Ata, 2015; Atanda et al., 2017; Dyrenko & Fuchs, 2018; Jamokovic & Fuchs, 2019; Bello et al., 2020). One of the researchers who studied both the duration and the formants of English produced by Nigerian speakers was Ata (2015). The study was conducted on the Hausa speech community in comparison with Malaysian speakers. The monophthongs studied in the *hvd* contexts were analysed using Praat, and the data was normalised in order to reduce the influence of non-linguistic factors in the results.

Table 2: Duration of monophthongs from Hausa speakers (Adapted from Ata, 2015)

Vowel	/ɪ/	/i/	/e/	/æ/	/ʌ/	/ɑː/	/ɒ/	/ɔː/	/ʊ/	/u/	/ɜː/
Male	114	168	149	133	108	153	125	149	145	163	203
Female	159	203	156	158	154	201	151	188	172	197	237

Table 3: Formants of vowels produced by Hausa speakers (Adapted from Ata, 2015)

Vow.	/	/ɪ/	/i/	/e/	/æ/	/ʌ/	/ɑː/	/ɒ/	/ɔː/	/ʊ/	/u/	/ɜː/
Male	F1	278	274	471	657	618	689	548	538	317	326	551
	F2	2204	2241	1971	1496	1347	1451	1159	1123	1076	1040	1674
Fem.	F1	304	308	584	767	672	752	621	603	330	349	664
	F2	2625	2835	2273	1708	1331	1552	187	1149	945	883	1602

Similar research has been carried out by Bello et al. (2020), targeting ten monophthongs which were contained in the *hvd* same word context with a focus on vowel quality. The results, which only focused on vowel quality (Formants values), were seen to be slightly different from those obtained by Ata (2015). Atanda et al. (2017) and Jamokovic and Fuchs (2019) also looked at the acoustics of the vowels, which are attested in the productions of Nigerian English speakers based on accents. The study included the three main Nigerian ethnic groups, the Hausa, the Ibo and the Yoruba speakers. After the researchers identified 5 (Atanda et al., 2017) and 7 vowels (Jamokovic & Fuchs, 2019), which are used by Nigerian speakers, they studied the formants of the vowels; the average values were compared with formant frequencies of RP.

As for Cameroonian speakers, acoustic studies of vowels produced by this speech community are very limited. Nevertheless, in 2012, Brozbă conducted a comparative acoustic study between CamE and RP using five vowels contained in Wells' (1982) lexical sets KIT, FLEECE, FOOT, GOOSE and GOAT. The findings of the study indicated that the FLEECE and GOOSE vowels were shortened and merged with their counterparts KIT and FOOT vowels, as illustrated by the durations of the sounds. It has also been discovered that there was a complete monophthongisation of the diphthong /əʊ/ in GOAT, which was rendered as [o] (Brozbă, 2012, p. 21).

It is worth mentioning that impressionistic studies of the English vowels produced by Cameroonian speakers revealed that the sounds are characterised by vowel lengthening, vowel shortening and merger.

3. Methodology

3.1 Participants

Thirteen girls and six boys, Undergraduate students at the University of Maroua, aged between 18 and 25, participated in this study. The students were all holders of the General Certificate of Education, Ordinary and Advanced level (GCE/OL and AL), which proves that the informants were ESL learners. In addition, no informant had any apparent articulation problem, which means that they could normally pronounce the sounds under study.

3.2 Stimuli

The six monophthongs were put in the *hvd* frame, notably in the words *heed, hid, hard, had, hoard* and *hod*. The words which have been typed and printed were arranged as follows: heed, hid, had, hard, hod, hoard. This arrangement of words is intended to avoid an unconscious short/lax alternation from readers, in which case their real competence would not have been tested.

3.3 Procedure

Prior to the recording of the participants' productions, a short questionnaire which carries a pseudonym, was first given to them in order to fill in some background information about their age, gender, and their diplomas. After filling in the questionnaire, a calm hall was used for the recording. The participants were taken one after the other, and once they entered the recording hall, a Jack Microphone was placed at about 10 to 15 cm from their mouth. Then, a brief instruction was given to the informant on the reading procedure, notably about their pseudonym and the necessity for pausing after reading every word. Then, PRAAT was opened, and the "New" button and "Record Mono" were selected before launching the recording process. The recording was conducted at 44100 HZ with the help of a Boya BY-M1 jack microphone. Each recorded file was first played to verify its quality, then saved as a Wav file with the pseudonym of the reader.

The recorded files were opened with a narrow-band spectrogram from PRAAT in order to read the duration of vowel segments and the formants F1 and F2. The analysis of duration was conducted by selecting the sound portion representing a word and by zooming in for the sound features to appear. This sound portion was then annotated in order to give a clearer picture of the portion occupied by each phoneme of the word in the sound spectrum. The duration was measured by selecting a portion representing the nucleus and by reading the duration of the selected segment. The formants F1 and F2 are obtained by placing the cursor at the centre of the indicated formants. Finally, the formants were typed on an EXCEL spreadsheet following a format

defined by NORM (Thomas & Tyler, 2007) and saved as "Tab Delimit" file. The file is therefore uploaded to *Norm Suite* at lingtool.com, where the data were treated and the vowels plotted automatically at their respective position.

4. Results and Discussion

4.1. Vowel duration

The duration of each vowel produced by male and female CamESL learners and the average duration for each group are presented in this section, with the differences between male and female speakers on the one hand and between CamESL learners and BrE vowels from Wells (1962) on the other hand. These results are presented in Tables 4, 5 and 6 below in milliseconds (ms).

Table 4: Duration of the vowels produced by male and female CamESL learners

Vowels	/i:/	/ɪ/	/æ/	/ɑ:/	/ɒ/	/ɔ:/
Male	298	163	193	308	162	318
Female	339	175	236	337	218	324
Average	**319**	**169**	**215**	**323**	**190**	**321**

Table 5: Comparison between the productions of male and female learners

Vowels	/i:/	/ɪ/	/æ/	/ɑ:/	/ɒ/	/ɔ:/
Male	298	163	193	308	162	318
Female	339	175	236	337	218	324
Difference	**41**	**12**	**43**	**29**	**56**	**6**

Table 6: Comparison between CamESL learners' productions and BrE

Vowels	/i:/	/ɪ/	/æ/	/ɑ:/	/ɒ/	/ɔ:/
CamESL Learners	319	169	215	323	190	321
BrE	293	139	210	335	178	330
Diff. with RP	**+26**	**+30**	**+5**	**-12**	**+12**	**-9**

The presentation of the duration in Tables 4, 5 and 6 indicates that learners have produced the target sounds with a clear distinction between short and long vowels, as seen in Table 4, both for the single male and female speakers and the group's average. The comparison of the duration from male and female learners' productions shows that there is a distinction between male and female CamESL speakers' productions. In fact, Table 5 indicates that the vowels produced by female learners are longer than those produced by male learners. Then, in Table 6, it can be observed that the comparison of the duration of the vowels articulated by CamESL learners differs from the duration of the same vowels from Wells' (1962) study. Finally, table 6 shows that /i:/, /ɪ/ /æ/ and /ɒ/ are longer in the learners' production than in BrE, while /ɑ:/ and /ɔ:/ are rather shorter.

4.2. Vowel formants

The formants F1 and F2 of the vowels produced by the CamESL learners were measured by reading the formants indications on the left of the spectrograms, as seen in Figures 1 and 2 below.

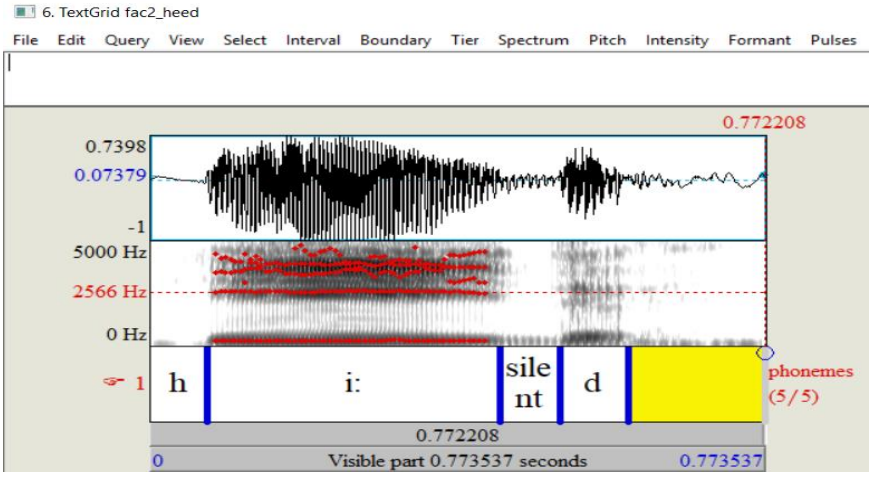

Figure 1

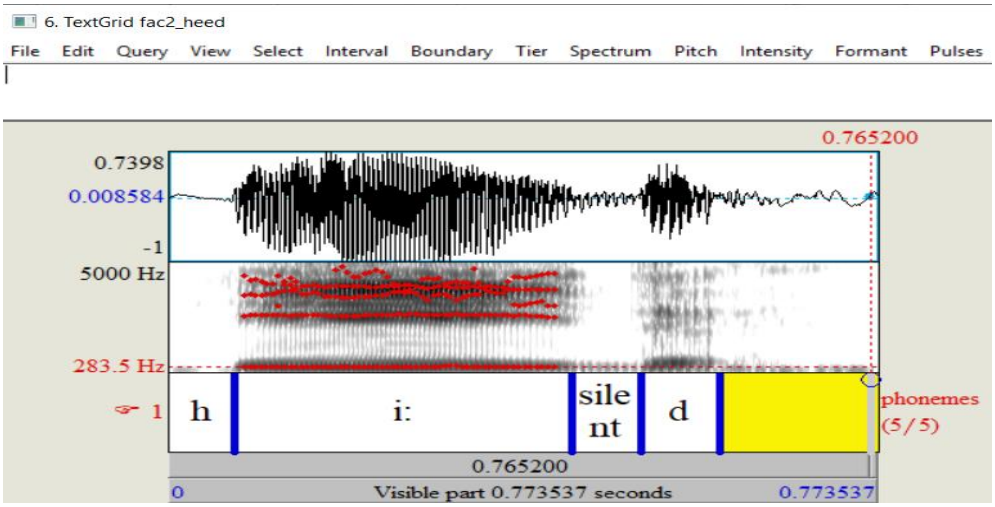

Figure 2

The analysis of the formants of male CamESL learners' productions yielded the frequencies for each of the six vowels under investigation. The formants values, as produced by each male speaker, can be found in Appendix C. These formants have been used to plot the position of each vowel, as seen in Figure 3.

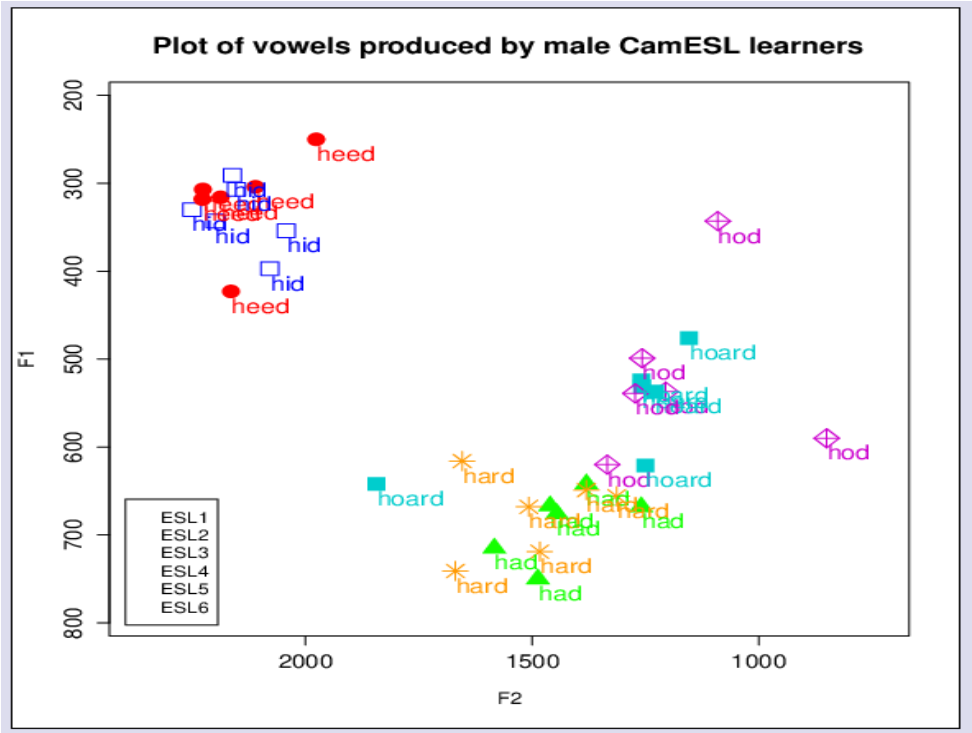

Figure 3

The plot of the vowels at their respective position shows a lot of differences between the positions of the same vowel. These within-gender differences can be seen from the spread of the words with the same colour in the plot and in the formant values for individual male CamESL speakers (see Appendix C). The mean formant frequencies for the six vowels produced by CamESL male learners are presented in Table 7 below, and the plot of the vowels' positions is in Figure 4.

Table 7: The formants of the six vowels produced by male CamESL learners in HZ

Vowels	/i:/		/ɪ/		/æ/		/ɑ:/		/ɒ/		/ɔ:/	
Freq.	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Form.	320	2148	337	2147	686	1435	675	1501	521	1168	555	1332

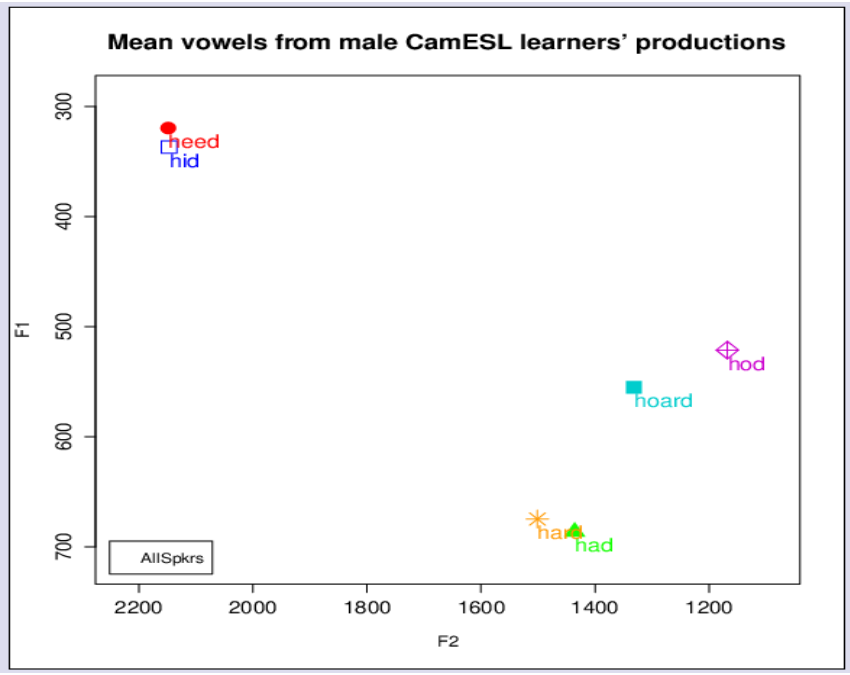

Figure 4

The analysis of the mean formants of the vowels and the plot of the vowels at their positions revealed that vowels /iː/ in *heed* and /ɪ/ in *hid* appear almost at the same position, which proves that there was no distinction in their production. Also, the sounds /æ/ and /ɑː/ are relatively more distant than a couple of high front vowels, but the distinction is neither significant nor accurate. In fact, it can be observed that the sound /ɑː/ in *hard* appears to have been articulated with a more advanced tongue than its counterpart lax vowel. Finally, the vowels /ɒ/ and /ɔː/ appear in two clearly distant positions, but the sound /ɒ/ in *hod* rather appears to be higher than the vowel /ɔː/ in *hoard*.

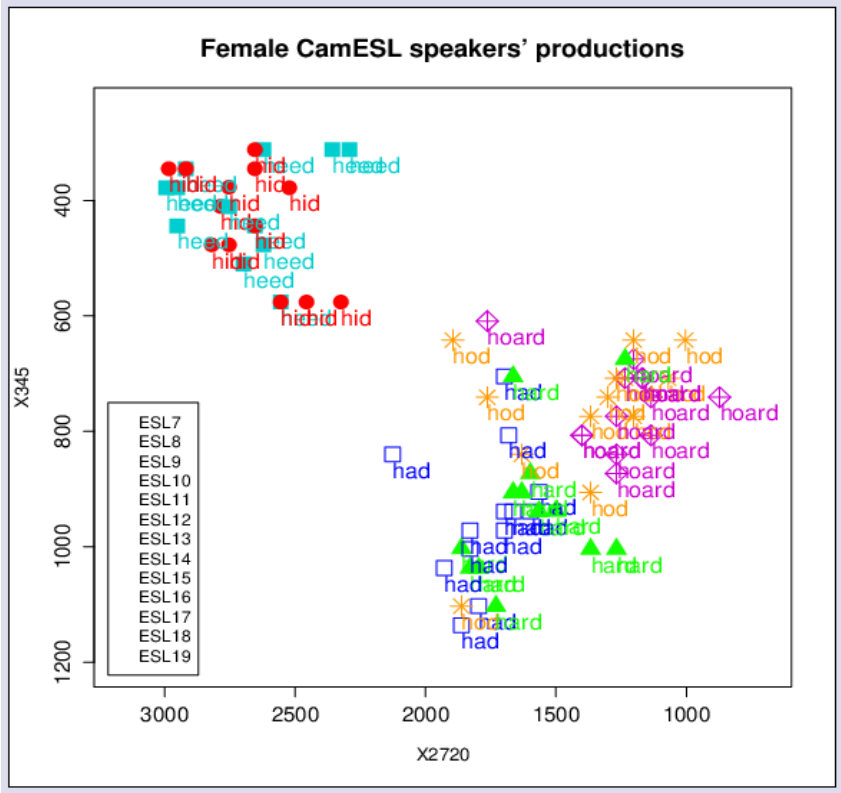

Figure 5

According to the plot of the vowels from individual female CamESL learners, there are also a lot of distances within the same gender that can be observed in the production of the same vowel sound as in the productions of male CamESL learners. The values of the formants for the vowels produced by each female speaker can be consulted in Appendix D. The mean formants from the productions of female CamESL learners and the plot of the vowels are respectively presented in Table 9 and Figure 5 below.

Table 9: Mean formants of vowels from female CamESL speakers in HZ

Vowels	/i:/		/ɪ/		/æ/		/ɑ:/		/ɒ/		/ɔ:/	
Frequent.	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Formants	408	2697	434	2679	946	1767	933	1593	764	1398	754	1253

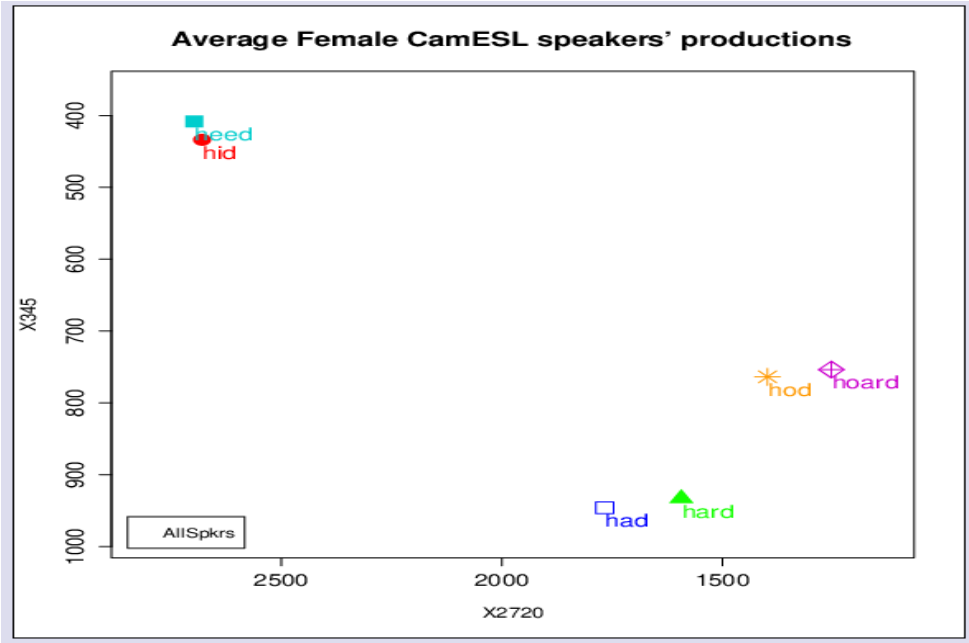

Figure 6

The plot of the vowels from female CamESL learners indicates that there is no significant distance between the positions of the vowels /i:/ and /ɪ/, just like in the male learners' productions, but the vowels /æ/ and /ɑ:/, and /ɒ/ and /ɔ:/ display a correct order of appearance, even though they do not occupy the accurate positions in the chart. In fact, /æ/ appears to have been articulated nearly as /ɑ: and both /ɒ/ and /ɔ:/ appear as low vowels, whereas they are high vowels.

The Average formants from CamESL male and female learners have been compared in order to better appraise the differences between their productions. Also, the average CamESL learners' vowels have been calculated from the formants of the vowels produced by the two groups, as presented in Table 10.

Table 10: Average formants and differences between male and female

Vowels	/i:/		/ɪ/		/æ/		/ɑ:/		/ɒ/		/ɔ:/	
Frequencies	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Male	320	2148	337	2147	686	1436	675	1501	521	1168	555	1332
Female	408	2697	434	2679	946	1767	933	1593	764	1398	754	1253
Average	364	2423	389	2413	816	1602	804	1547	643	1283	655	1293
Differences	88	549	97	532	260	331	258	92	243	230	199	79

The difference occurs more in the F2 of the sounds /i:/, /ɪ/, /æ/ and /ɒ/, and the F1 of the sounds /æ/, /ɑ:/, /ɒ/ and /ɔ:/. The formants from the students' productions are also compared with those from BrE speakers from Wells (1962) in order to highlight the differences with the formants from L1 speakers, even though the BrE data is not recent.

Table 11: Comparison of the formants of vowels from BrE and CamESL in HZ

Sounds	/i:/		/ɪ/		/æ/		/ɑ:/		/ɒ/		/ɔ:/	
Freq.	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
CamESL	364	2423	389	2413	816	1602	804	1547	643	1283	655	1293
BrE	303	2654	384	2174	1018	1799	910	1316	751	1215	389	888
Diff.	**+61**	**-231**	**+5**	**+239**	**-202**	**-197**	**-106**	**+231**	**-108**	**+68**	**+266**	**+405**

The comparison of the formants of the vowels produced by CamESL learners and BrE indicates that there are significant differences between the productions, both at the levels of F1 and F2, except for the F1 of the sound /ɪ/, which is only different with 5HZ. These differences can be considered as the rate of deviation of CamESL learners' productions.
The productions of the two speech communities are plotted in Figure 7, where arrows are used to indicate the distance between the positions of CamESL learners' vowels and those from BrE speakers; circles are used to indicate that the couples of vowels from CamESL learners appear in almost the same space.

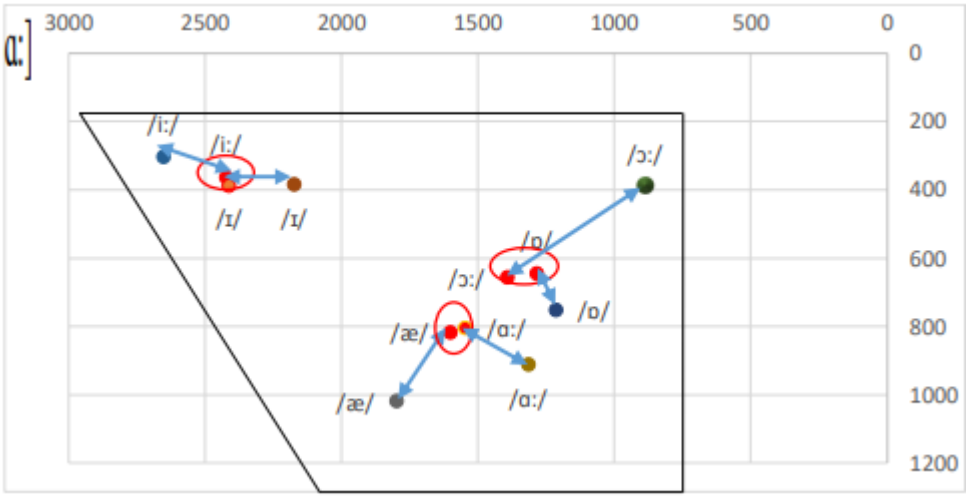

Figure 7

It can be observed from Figure 7 that the three pairs of vowels from CamESL learners appear almost at the same vowel space as indicated by the circles. The arrows show that the vowel which is the most distant from the two speech communities is the vowel /ɔ:/. It can also be observed that the vowels /i:/ and /ɪ/ from the learners' production appear in the middle of the distance between that couple of vowels in BrE, and the sounds /ɔ:/ and /ɒ/ produced by the learners occupy nearly the space with the BrE /ɒ/ sound whereas the couple /æ/ and /ɑ:/ from CamESL learners are higher that the BrE productions.

The distinction of short and long vowels and their formants from CamESL learners is summarised in Table 12 below in order to better perceive the merger phenomenon from the learners' productions.

Table 12: Difference between the couples of vowels from CamESL speakers

Sounds features	[i:] - [ɪ]	[ɑ:] - [æ]	[ɔ:] - [ɒ]
Duration	150ms	108ms	131ms
F1	25HZ	12HZ	12HZ
F2	10HZ	55HZ	10HZ

Table 12 shows that the difference between the couples of vowels was clearly established by CamESL learners as far as duration is concerned, but the difference in sound quality was not significant among the couples of vowels from the learners' productions.

This article consisted of an analysis of the duration and formants of six monophthongs produced by undergraduate CamESL learners using the acoustic analysis method. The observation of the results provides an insight into the way CamESL students produced the six English vowel sounds by bringing out the accurate and inaccurate features from their productions. This section

of the paper discusses the features of the learners' pronunciation, namely partial merger, vowel lengthening and vowel shortening, and inaccurate tongue advancement and also brings out some accurate features from the learners' articulations.

4.3. Partial merger

The merger phenomenon constitutes a dominant feature of English around the world, both in the speech of L1 and L2 speakers (Mbangwana, 1987; Simo Bobda, 2004; Koffi, 2013; Strelluf, 2014; Ketcha, 2018). The phenomenon which has been identified in this study can be referred to as partial merger. In fact, it has been discovered from the analysis of the learners' production that the speakers clearly distinguish short and long vowels in duration, as seen in Table 12. This table indicates that the difference between /iː/ and /ɪ/ is 150ms; /ɑː/ and /æ/ 108ms and finally, /ɔː/ and /ɒ/ 131ms; meanwhile, an observation of the quality of the vowels from their formants F1 and F2 values completely contradicts this results. As for the quality of the vowels, it can be seen that the couples of vowels have been articulated nearly in the same way as seen in Figures 4, 6 and 7. The articulation of the vowels /æ/ and /ɑː/ is nearly the same since the difference in F1 (tongue height) is only 12HZ. Therefore, the high front vowels /iː/ and /ɪ/, and the low front ones /æ/ and /ɑː/ are partially merged since the merger phenomenon only concerns their quality and not their length. This result is also confirmed by the values obtained from the difference in the values of the formants of the couples of vowels in Table 12.

4.4. Inaccurate tongue advancement

It has been observed from the analysis of formants that the major deviation from the learners' production occurred in tongue advancement, which determines the vowel's horizontal position. In fact, it can be seen from the plots in Figures 3, 4, 5, 6 and 7 that CamESL learners failed to properly place advance or retract their tongue when producing the vowels. Thence, /iː/ and /ɪ/, /ɑː/ and /æ/ appear at nearly the same horizontal vowel space, and also /ɔː/ and /ɒ/ for male learners. This phenomenon can also be seen from the magnitude of the difference in F2 between CamESL learners' productions and BrE, as seen in Table 11.

4.5. Within-gender disparity

This phenomenon can be observed from the way the learners' individual productions are scattered in the chart. In fact, Figures 3 and 5 show that the plot of the vowels from the productions of individual speakers is very scattered, with some vowels significantly distant from others. This individual vowels' distance suggests that there is a considerable within-gender disparity between the productions of learners from the same group. This disparity is observed from the productions of both male and female speakers, where some vowels appear at the accurate positions while others appear very far from the normal vowels space area.

4.6. Some accurate features

The analysis of the duration and formants of the vowels from the learners' production has revealed many accurate features. The first accurate feature for CamESL productions in the present study is the difference between male and female speakers' productions. In fact, it is established that the duration and formants of the vowels produced by male and female speakers differ, with female speakers producing longer vowels than male speakers (Hillenbrand et al. 1995). This difference is also perceived in this study, as seen in Table 5, and the productions of female speakers are longer than those of male learners, except for the sound /ɔː/, which was rather longer in the male informants' production.

The second accurate element from learners' rendition is the duration of some vowels. In fact, the difference between the durations of the vowels / æ / and /ɒ/ from CamESL learners and BrE from Wells (1962) is not significant as /æ/ is only different with 5ms and /ɔː/ with 9ms. The last acceptable feature from CamESL learners' productions is the learners' tongue height in the production of the sound /ɪ/ where the F1 of the vowel from the two groups only differ with 5HZ, as seen in Table 11.

5. Conclusion

This paper explored the duration and formant frequencies of six English monophthongs produced by undergraduate CamESL learners. The findings revealed that the learners' productions were characterised by partial merger as they contained both accurate and inaccurate features. The analysis of the duration of the vowels indicated that the respondents successfully distinguished between long and short vowels, while the analysis of formants proved that the vowels were produced with the same vowel quality. It was also discovered from the learners' individual productions that there was a significant dispersion, even among respondents of the same gender. The use of PRAAT to analyse CamESL learners' spoken productions contributed to the existing literature in the area by providing the duration and formants of the vowels produced by the learners, which helped in bringing out more details on the extent of accuracy and deviation instead of the correct/incorrect results obtained from previous studies which used judgemental method of data analysis. Nevertheless, the size of the sample and the number of vowels used in the study constitute its limitations. The input of this study raises the necessity for a sociophonetic acoustic study of the English spoken by Cameroonians in order to have numerical data that will serve for diachronic and cross-dialectal studies.

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Appendix A

Duration of vowels produced by each male CamESL learners

Sounds	/i:/	/ɪ/	/æ/	/ɑ:/	/ɒ/	/ɔ:/
ESL1	232	186	125	255	140	283
ESL2	271	156	142	259	192	205
ESL3	368	109	229	342	138	270
ESL4	328	162	177	351	165	430
ESL5	347	161	216	290	144	375
ESL6	242	204	267	349	195	345

Appendix B

Duration of vowels from female CamESL learners

Speakers	**SOUNDS**					
	/i:/	/ɪ/	/æ/	/ɑ:/	/ɒ/	/ɔ:/
ESL7	207	163	248	294	153	199
ESL8	270	206	212	253	213	298
ESL9	351	162	303	350	437	170
ESL10	380	328	456	413	515	387
ESL11	480	173	168	380	142	339
ESL12	240	116	115	265	131	226
ESL13	227	135	193	265	131	241
ESL14	431	183	171	371	155	373
ESL15	363	190	287	356	222	389
ESL16	343	118	141	243	116	337
ESL17	439	219	282	459	273	536

ESL18	233	126	279	324	158	327
ESL19	448	162	213	403	192	385

Appendix C

Formants of the vowels produced by male CamESL learners

	/iː/		/ɪ/		/æ/		/ɑː/		/ɒ/		/ɔː/	
	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
ESL1	423	2164	397	2078	715	1583	741	1669	343	1090	476	1154
ESL2	304	2110	330	2250	667	1460	719	1483	537	1205	537	1228
ESL3	316	2187	343	2199	750	1487	656	1313	499	1257	531	1257
ESL4	307	2226	307	2152	668	1259	668	1507	620	1334	524	1259
ESL5	250	1976	354	2042	642	1380	616	1654	590	850	642	1843
ESL6	318	2227	291	2161	676	1445	649	1380	539	1272	621	1250

Appendix D

Formants of the vowels produced by female CamESL learners

	/iː/		/ɪ/		/æ/		/ɑː/		/ɒ/		/ɔː/	
	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
ESL7	345	2720	345	2654	905	1565	938	1500	708	1235	708	1235
ESL8	444	2654	377	2753	939	1598	939	1565	708	1070	708	1169
ESL9	378	2994	345	2984	1136	1862	1003	1862	741	1763	807	1400
ESL10	312	2357	378	2522	1103	1796	1037	1829	1103	1862	807	1400
ESL11	345	2918	410	2786	972	1829	1103	1730	642	1004	675	1202
ESL12	444	2951	477	2819	939	1697	906	1664	708	1269	708	1169
ESL13	312	2621	312	2654	705	1697	705	1664	642	1895	609	1763
ESL14	378	2951	345	2918	1004	1829	1037	1796	774	1202	741	1136
ESL15	312	2291	576	2324	1037	1928	1004	1268	840	1631	807	1136
ESL16	576	2555	576	2555	939	1664	873	1598	741	1301	840	1268
ESL17	510	2697	576	2456	807	1681	1004	1367	774	1367	873	1268
ESL18	477	2621	444	2654	840	2126	675	1235	906	1367	741	873
ESL19	411	2753	477	2753	972	1697	906	1631	642	1202	774	1268