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Article

An Acoustic Analysis of English Monophthong Vowels Produced by Young Adults Using Praat

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A B S T R A C T

This study analyses the acoustic characteristics of English monophthong vowels produced by young adults using Praat software. The analysis focuses on the first formant (F1) and second formant (F2) frequencies to identify variations in vowel production. This study uses a descriptive approach involving audio recordings of three young adult speakers and one native speaker who pronounce ten selected English words. The recordings are examined using Praat to identify vowel segments and measure their F1 and F2 values in Hertz (Hz). This research was carried by qualitative method. The results show variations in formant frequencies across speakers and words. The findings indicate that vowel production varies according to the speaker and the phonetic environment. The study also demonstrates that Praat is a useful tool for examining vowel characteristics through acoustic measurements. These findings may contribute to a better understanding of English vowel production and support pronunciation learning among English learners.

Keywords: *Acoustic Analysis, English Monophthongs, Formant Frequencies, Praat, Vowel Production*

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INTRODUCTION

Phonetics and phonology provide essential theoretical foundations for understanding the production and organization of speech sounds, particularly English vowels. Phonetics focuses on the physical properties of speech sounds, including their articulation and acoustic characteristics, whereas phonology examines how sounds function within a language system (Forel & Puskás, 2005; McMahon, 2002). Hayes (2009) emphasizes the relationship between phonetic evidence and phonological analysis, suggesting that observable speech characteristics contribute to understanding sound patterns. In English, vowels are classified according to tongue height, tongue position, and lip rounding. Unlike diphthongs, which involve a movement between vowel qualities, monophthongs are generally characterized by a relatively stable articulatory configuration. Nevertheless, their acoustic realization may vary across speakers and linguistic contexts.

Acoustic phonetics provides measurable evidence for examining vowel production through formant frequencies. The first formant (F1) is generally associated with vowel height, with higher F1 values corresponding to lower tongue positions. Meanwhile, the second formant (F2) is associated with the front–back dimension of vowel articulation, with higher F2 values generally indicating a more fronted tongue position (Ladefoged & Johnson, 2014). These acoustic parameters allow researchers to describe differences in vowel quality through numerical measurements rather than relying exclusively on auditory impressions. However, differences in formant frequencies should not automatically be interpreted as pronunciation errors because vowel realization may also be influenced by individual physiological characteristics, speaking styles, and phonetic contexts.

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The acoustic analysis of English vowels is particularly relevant in English as a Foreign Language (EFL) contexts, where learners may encounter vowel distinctions that differ from those in their first language. Indonesian and English have different vowel systems, particularly regarding the number of vowel contrasts and the distinctions involving vowel quality. Consequently, Indonesian learners of English may produce certain English vowels with acoustic characteristics that differ from those observed in particular native-speaker varieties. Such differences may reflect the influence of first-language phonological categories, although their interpretation requires consideration of individual linguistic backgrounds and pronunciation experience. Understanding these potential cross-linguistic influences provides a relevant basis for investigating English vowel production among young adult speakers.

Recent empirical studies have examined English vowel production through acoustic measurements. Azzahra et al. (2024) compared English vowel formant frequencies produced by native and Indonesian non-native speakers using Praat. Their findings identified variation in F1 measurements across speakers, illustrating differences in the acoustic realization of selected English monophthongs. Similarly, Kurniawan et al. (2024) investigated English vowel production among Indonesian speakers by examining F1 and F2 values and comparing them with American English reference productions. Their findings showed particularly noticeable differences in the production of /æ/ and /ɑ/, with linguistic factors playing a more prominent role than the non-linguistic factors examined in their study. These investigations demonstrate the relevance of acoustic measurements for describing English vowel variation among Indonesian speakers.

Although both studies employed acoustic analysis, their research emphases were not identical. Azzahra et al. (2024) primarily emphasized formant differences between native and non-native speakers, particularly through F1 measurements, whereas Kurniawan et al. (2024) examined a broader set of vowel contrasts and considered possible linguistic and non-linguistic influences. Together, these studies suggest that English vowel production cannot be adequately characterized through a single acoustic parameter or by assuming uniform pronunciation patterns across speakers. Their findings also highlight the importance of interpreting formant differences in relation to the specific vowel categories, speakers, and methodological conditions being investigated.

Praat is a speech-analysis program that enables researchers to examine recorded speech through waveforms, spectrograms, and acoustic measurements. Boersma & Heuven (2001) describe its application in speech analysis and manipulation. In vowel research, Praat can be used to identify vowel segments and extract their formant frequencies, particularly F1 and F2. These measurements provide a quantitative basis for describing acoustic variation and comparing vowel productions. Nevertheless, Praat functions as an analytical instrument rather than an independent intervention for improving pronunciation. Its contribution to the present study lies in facilitating the measurement and visualization of vowel characteristics, not in demonstrating improvements in pronunciation proficiency or learning outcomes.

Despite the contributions of previous studies, further descriptive investigation is warranted to examine how selected English vowel productions vary across individual young adult speakers within a small-scale dataset. Existing research has documented acoustic differences among Indonesian speakers and between native and non-native productions, but the interpretation of such differences remains dependent on the specific participants, target vowels, and lexical items examined. The present study therefore focuses on a descriptive comparison of F1 and F2 measurements obtained from ten selected English words produced by three young adult speakers and one native-speaker reference. Rather than treating the use of Praat itself as a research novelty, the study contributes a context-specific account of acoustic variation across the selected speakers and words.

The native speaker in this study serves as a descriptive comparison point rather than an absolute standard of correct English pronunciation. A single native speaker cannot represent the complete range of vowel realizations across English varieties. Accordingly, differences between the young adult speakers and the reference speaker are interpreted as acoustic differences rather than direct evidence of incorrect pronunciation. This approach

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recognizes that vowel formant frequencies may vary because of linguistic experience, individual vocal tract characteristics, accent, and recording conditions. It also avoids generalizing the findings beyond the participants and speech samples examined.

Therefore, this study aims to analyze the acoustic characteristics of English vowel productions among young adult speakers using Praat, focusing on the first and second formant frequencies. Specifically, it seeks to describe F1 and F2 variation across selected English words, compare the measurements of three young adult speakers with those of a native-speaker reference, and interpret the observed differences in relation to vowel articulation and relevant phonetic considerations. By adopting a descriptive acoustic approach, this research contributes to the understanding of English vowel variation in a small group of speakers and provides a basis for further investigations involving larger participant samples and more systematically controlled phonetic environments.

METHOD

Research Design

This study employed a descriptive acoustic approach to investigate the production of English vowel sounds by young adult speakers using Praat software. The study focused on the first formant (F1) and second formant (F2) frequencies as acoustic indicators of vowel quality. F1 was examined in relation to vowel height, whereas F2 was considered in relation to the front–back dimension of vowel articulation (Kent & Vorperian, 2018). The research involved a descriptive comparison of vowel productions obtained from three young adult speakers and one native English speaker. The native speaker served as an acoustic reference for comparing the formant measurements rather than as an absolute standard of correct pronunciation. This distinction was necessary because English vowel production varies across native speakers depending on accent, individual vocal tract characteristics, and speaking style (Hillenbrand et al., 1995; Whalen et al., 2018).

The study examined ten selected English words containing different vowel categories. The recorded speech samples were analyzed using Praat to identify vowel segments and extract their F1 and F2 frequencies in Hertz (Hz), following established acoustic phonetic analysis procedures (Boersma, 2001). The measurements were compared across participants and lexical items to identify patterns of acoustic similarity and variation. Previous studies have also used formant measurements to examine English vowel production among Indonesian learners (Widagsa et al., 2018; Widagsa & Putro, 2017). Given the limited number of participants, the study was descriptive rather than inferential. Its purpose was not to determine pronunciation accuracy or establish generalizable differences between native and non-native speakers, but to document the acoustic characteristics of the selected vowel productions.

Participants

The participants consisted of three young adult speakers and one native English speaker whose pronunciations were used for descriptive comparison. The three young adult speakers were identified as Speaker 1, Speaker 2, and Speaker 3, while the native English speaker was identified as the reference speaker. Each speaker contributed pronunciation data for the same ten selected English words. The recordings were analyzed individually to examine differences in F1 and F2 values across speakers. Similar comparative approaches have been employed in previous acoustic studies examining English vowel production among Indonesian learners and native English speakers (Widagsa et al., 2018; Widagsa & Putro, 2017).

The native English speaker was included as a descriptive reference rather than as a representative of all native English accents. This consideration is supported by Clopper et al. (2005), who identified acoustic differences among six regional varieties of American English. Similarly, Laturnus (2020) reported substantial variability in the acoustic characteristics of English produced by speakers with different linguistic backgrounds. Consequently, differences between the three young adult speakers and the reference speaker were

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interpreted as acoustic variation, without automatically classifying the young adults' pronunciations as incorrect. The linguistic backgrounds of the participants, including their first languages, English learning experiences, and accent characteristics, are relevant considerations in interpreting vowel production. Kurniawan et al. (2024) also demonstrated the relevance of linguistic and phonetic factors in explaining English vowel production among Indonesian speakers. However, these characteristics must be established from participant information rather than inferred solely from the acoustic measurements.

Research Instruments and Materials

The primary research instrument was Praat, a speech-analysis software program used to examine acoustic characteristics of recorded speech. Praat provides waveform and spectrogram displays that facilitate the identification of speech segments and the extraction of formant frequencies. The study focused on two acoustic measurements: the first formant (F1) and the second formant (F2). These measurements were expressed in Hertz (Hz) and used to describe differences in vowel production across speakers.

The research materials consisted of ten English words: *kitchen, meat, fish, vegetables, fruit, menu, waitress, dessert, wine,* and *customer*. These words were selected as lexical items containing different English vowel categories. Oxford Learner's Dictionaries was used as a supplementary pronunciation reference for checking phonemic transcriptions and identifying the vowel categories associated with the selected words. However, the dictionary was not treated as the source of acoustic measurements. The F1 and F2 values were obtained from the speech recordings analyzed using Praat.

Because several selected words contain more than one vowel and some contain diphthongs, the lexical materials were not restricted exclusively to monophthong-containing syllables. The analysis therefore requires clear identification of the specific vowel segment represented by each reported formant measurement.

Target Words and Phonetic Environments

The ten target words were examined according to their phonemic transcriptions, vowel categories, and surrounding consonantal environments. Identifying these characteristics is important because vowel realization may be influenced by adjacent sounds, syllable structure, and stress placement. Table 1 presents the selected lexical items, their phonemic transcriptions, the vowel categories identified in the original dataset, and relevant phonetic contexts.

Table 1. Target Words, Phonemic Transcriptions, and Phonetic Environments

No.	Target Word	IPA Transcription	Vowel (s)	Phonetic Environment
1	Kitchen	/ˈkɪtʃɪn/	/ɪ/	/ɪ/ occurs before /tʃ/ in the first syllable and before /n/ in the second syllable
2	Meat	/miːt/	/iː/	/iː/ occurs between /m/ and /t/
3	Fish	/fɪʃ/	/ɪ/	/ɪ/ occurs between /f/ and /ʃ/
4	Vegetables	/ˈvedʒtəbl/	/e/	/e/ occurs between /v/ and /dʒ/
5	Fruit	/fruːt/	/uː/	/uː/ occurs after /fr/ and before /t/
6	Menu	/ˈmenjuː/	/e/, /uː/	/e/ occurs between /m/ and /n/; /uː/ follows /j/
7	Waitress	/ˈweɪtrəs/	/eɪ/, /ə/	/eɪ/ occurs after /w/ and before /t/; /ə/ occurs between /r/ and /s/

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No.	Target Word	IPA Transcription	Vowel (s)	Phonetic Environment
8	Dessert	/dɪˈzɜːt/	/ɪ/, /ɜː/	/ɪ/ occurs between /d/ and /z/; /ɜː/ occurs before /t/
9	Wine	/waɪn/	/aɪ/	/aɪ/ occurs between /w/ and /n/
10	Customer	/ˈkʌstəmə/	/ʌ/, /ə/	/ʌ/ occurs between /k/ and /s/; reduced vowels occur in unstressed syllables

Note. The phonemic transcriptions follow the British English transcription convention used in the original manuscript. The phonetic environments are identified from the transcriptions. Words containing multiple vowels require confirmation of the exact segment measured in Praat. The diphthongs /eɪ/ and /aɪ/ should not be treated as monophthongs.

Data Collection Procedure

The data consisted of audio recordings of the ten selected English words produced by the four speakers. The recordings provided the speech samples required for acoustic analysis. The target words were used consistently across speakers to allow descriptive comparison of the corresponding formant measurements. Each recording was examined to identify the relevant vowel segments within the selected lexical items.

According to the original research description, the recordings were conducted in a relatively quiet environment to reduce interference from background noise. However, the recording equipment, microphone specifications, sampling rate, bit depth, microphone distance, and additional noise-reduction procedures were not specified in the available documentation.

These technical details are important because recording quality and measurement conditions may affect the reliability of acoustic analysis. They should therefore be reported based on the actual recording procedure and equipment used during data collection. The collected recordings were subsequently analyzed using Praat to obtain F1 and F2 measurements for the selected vowel productions.

Data Analysis

The recorded speech samples were analyzed using Praat software to identify vowel segments and measure their acoustic characteristics. The analysis focused on F1 and F2 frequencies, which were used to describe vowel quality across speakers and lexical items. First, the audio recordings were examined through waveform and spectrogram displays to identify the vowel portions of the selected words. The vowel segments were distinguished from surrounding consonantal sounds based on the acoustic information available in the recordings.

Second, the identified vowel segments were examined to obtain F1 and F2 measurements in Hertz (Hz). F1 was interpreted as an acoustic correlate of vowel height, while F2 was interpreted as an acoustic correlate of the front–back dimension of vowel articulation. Higher F1 values generally correspond to lower vowel positions, whereas higher F2 values generally correspond to more fronted vowel positions (Ladefoged & Johnson, 2014).

Third, the extracted measurements were organized according to speaker and target word. The values obtained from the three young adult speakers were compared descriptively with those of the native-speaker reference to identify similarities and differences in acoustic vowel characteristics.

Fourth, the measurements were considered in relation to the phonemic categories and relevant phonetic environments of the selected words. However, because the study did not systematically control neighboring consonants or other contextual factors, differences across

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words were treated as descriptive observations rather than direct evidence of phonetic-environment effects.

Finally, the results were interpreted cautiously by considering potential sources of acoustic variation, including individual speaker characteristics, vowel categories, accent differences, and recording conditions. Differences in F1 and F2 values were not automatically categorized as pronunciation errors because the study did not establish independent perceptual judgments, validated acoustic reference ranges, or explicit criteria for determining pronunciation accuracy.

The analysis was limited to descriptive comparisons of the available measurements. No statistical generalization or causal interpretation was intended. This approach enabled the study to document acoustic variation in the selected speech samples while acknowledging the methodological limitations associated with the small participant sample and the available recording information.

FINDINGS AND DISCUSSION

Acoustic Characteristics of English Vowel Productions

This section presents the acoustic characteristics of English vowel productions obtained from three young adult speakers and one native English reference speaker. The analysis focuses on the first formant (F1) and second formant (F2) frequencies extracted using Praat. The measurements are examined descriptively to identify differences across speakers and selected English words.

The dataset consists of ten lexical items produced by each speaker, resulting in 40 reported pairs of F1 and F2 measurements. These measurements provide the basis for comparing acoustic characteristics across the four speakers. However, because several words contain multiple vowels and the dataset reports only one F1–F2 pair per word, the findings are interpreted as word-associated acoustic observations until the specific measured vowel segments can be confirmed.

Acoustic Measurements of the Native-Speaker Reference

Table 2 The Tabulation Results of The First Young Adults' Features

No.	Vowels	Words	F1	F2
1	**/ɪ/**	Kitchen /ˈkɪtʃɪn/	643 Hz	2504 Hz
2	**/iː/**	Meat /miːt/	526 Hz	2170 Hz
3	**/ɪ/**	Fish /fɪʃ/	1347 Hz	2549 Hz
4	**/e/**	Vegetables /ˈvedʒtəbl/	560 Hz	1928 Hz
5	**/uː/**	Fruit /fruːt/	566 Hz	2186 Hz
6	**/e/, /uː/**	Menu /ˈmenjuː/	424 Hz	1889 Hz
7	**/eɪ/, /ə/**	Waitress /ˈweɪtrəs/	885 Hz	2258 Hz
8	**/ɪ/, /ɜː/**	Dessert /dɪˈzɜːt/	697 Hz	2331 Hz
9	**/aɪ/**	Wine /waɪn/	482 Hz	1838 Hz
10	**/ʌ/, /ə/**	Customer /ˈkʌstəmə/	263 Hz	1591 Hz

Table 2 presents the acoustic measurements obtained from the native-speaker reference. The F1 values range from 510 Hz in the word *dessert* to 1251 Hz in *fish*, while the F2 values range from 997 Hz in *meat* to 2373 Hz in *fish*. These findings indicate considerable variation in the reported acoustic measurements across the selected lexical items. The word

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fish exhibits the highest F1 and F2 values, whereas *dessert* has the lowest F1 value and *meat* has the lowest F2 value. Notably, the relatively low F2 measurement for *meat* differs from the acoustic characteristics generally expected for the high front vowel /iː/. This discrepancy requires further examination of the original recording and formant-tracking procedure before a definitive articulatory interpretation can be made.

Acoustic Measurements of the First Young Adult Speaker

Table 3 The Tabulation Result of The Second Young Adults Features

No.	Vowels	Words	F1	F2
1	**/ɪ/**	Kitchen /ˈkɪtʃɪn/	638 Hz	2190 Hz
2	**/iː/**	Meat /miːt/	551 Hz	2081 Hz
3	**/ɪ/**	Fish /fɪʃ/	1169 Hz	2531 Hz
4	**/e/**	Vegetables /ˈvedʒtəbl/	788 Hz	1777 Hz
5	**/uː/**	Fruit /fruːt/	738 Hz	1901 Hz
6	**/e/, /uː/**	Menu /ˈmenjuː/	470 Hz	1771 Hz
7	**/eɪ/, /ə/**	Waitress /ˈweɪtrəs/	735 Hz	2097 Hz
8	**/ɪ/, /ɜː/**	Dessert /dɪˈzɜːt/	650 Hz	2029 Hz
9	**/aɪ/**	Wine /waɪn/	661 Hz	1777 Hz
10	**/ʌ/, /ə/**	Customer /ˈkʌstəmə/	889 Hz	1744 Hz

Table 3 presents the F1 and F2 measurements of the first young adult speaker. The F1 values range from 263 Hz in *customer* to 1347 Hz in *fish*, whereas the F2 values range from 1591 Hz in *customer* to 2549 Hz in *fish*. The word *fish* demonstrates the highest measurements for both formants. Compared with the native-speaker reference, Speaker 1 produces an F1 value that is 96 Hz higher and an F2 value that is 176 Hz higher for this word. Meanwhile, *meat* has an F1 value of 526 Hz and an F2 value of 2170 Hz, which differ from the corresponding reference measurements. These observations demonstrate variation across the selected lexical items. However, the differences cannot automatically be interpreted as pronunciation errors or attributed to particular phonetic environments because the study did not independently establish pronunciation accuracy or systematically control the surrounding consonants.

Acoustic Measurements of the Second Young Adult Speaker

Table 4 The Tabulation Result of The Third Young Adults Features

No.	Vowels	Words	F1	F2
1	**/ɪ/**	Kitchen /ˈkɪtʃɪn/	701 Hz	2092 Hz
2	**/iː/**	Meat /miːt/	607 Hz	2164 Hz
3	**/ɪ/**	Fish /fɪʃ/	938 Hz	2357 Hz
4	**/e/**	Vegetables /ˈvedʒtəbl/	780 Hz	2007 Hz
5	**/uː/**	Fruit /fruːt/	886 Hz	1669 Hz
6	**/e/, /uː/**	Menu /ˈmenjuː/	580 Hz	1925 Hz
7	**/eɪ/, /ə/**	Waitress /ˈweɪtrəs/	819 Hz	2059 Hz

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8	**/ɪ/, /ɜː/**	Dessert /dɪˈzɜːt/	461 Hz	1784 Hz
9	**/aɪ/**	Wine /waɪn/	713 Hz	1712 Hz
10	**/ʌ/, /ə/**	Customer /ˈkʌstəmə/	872 Hz	1805 Hz

Table 4 presents the acoustic measurements of the second young adult speaker. The F1 values range from 470 Hz in *menu* to 1169 Hz in *fish*, while the F2 values range from 1744 Hz in *customer* to 2531 Hz in *fish*. Similar to the first speaker, *fish* exhibits the highest F1 and F2 measurements. Compared with the native-speaker reference, Speaker 2 produces an F1 value that is 82 Hz lower and an F2 value that is 158 Hz higher for this word.

Another notable difference is observed in *meat*, where Speaker 2 produces an F1 value of 551 Hz and an F2 value of 2081 Hz. The F2 measurement is substantially higher than the reference speaker's value of 997 Hz. Nevertheless, this difference should be interpreted cautiously because a single reference speaker does not represent the complete range of native English vowel realizations. The results indicate that acoustic differences vary across lexical items and speakers rather than following a uniform pattern.

Comparison of Acoustic Measurements Across Speakers

A comparison of the four speakers reveals similarities and differences in the reported F1 and F2 measurements. One consistent observation is that *fish* exhibits the highest F1 and F2 values across all four speakers. The F1 values for *fish* are 1251 Hz for the native-speaker reference, 1347 Hz for Speaker 1, 1169 Hz for Speaker 2, and 938 Hz for Speaker 3. The corresponding F2 values are 2373 Hz, 2549 Hz, 2531 Hz, and 2357 Hz, respectively.

The difference between the highest and lowest F1 measurements for *fish* is 409 Hz, while the corresponding F2 difference is 192 Hz. These findings suggest that the acoustic variation for this lexical item is more pronounced along the F1 dimension. In contrast, the word *meat* demonstrates a substantial difference in F2 measurements between the native-speaker reference and the three young adult speakers. The reference speaker has an F2 value of 997 Hz, whereas Speakers 1, 2, and 3 have values of 2170 Hz, 2081 Hz, and 2164 Hz, respectively.

The relatively low F2 value reported for the reference speaker requires further verification because it differs considerably from the expected acoustic characteristics of /iː/. Therefore, the observed differences should not be interpreted as evidence that the young adult speakers produced the vowel incorrectly.

Visualization and Interpretation of F1–F2 Distributions

Figure 1 presents the distribution of the reported F1 and F2 measurements across the four speakers. The visualization provides a descriptive representation of the acoustic differences associated with the selected lexical items. The measurements show variation across speakers and words, with some observations occupying relatively similar acoustic regions and others demonstrating substantial differences. The word *fish* exhibits relatively similar F2 measurements across speakers, while its F1 measurements vary more considerably.

Meanwhile, the word *meat* demonstrates a noticeable difference between the reference speaker and the three young adult speakers, particularly along the F2 dimension. However, the figure should be interpreted as a descriptive representation of word-associated formant measurements rather than a fully validated vowel-space plot. Because the dataset does not consistently identify the exact vowel segment measured in each lexical item, the observations cannot yet be confidently assigned to individual vowel categories

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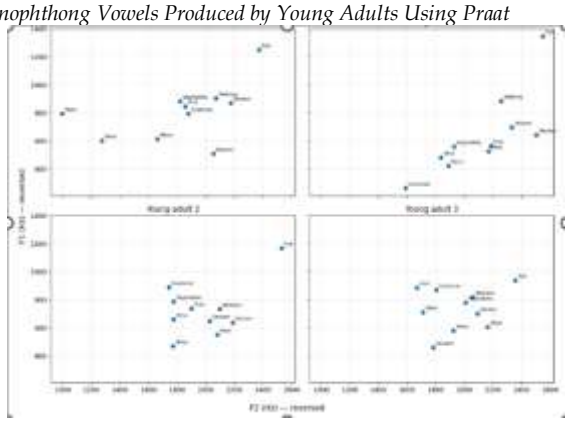


Figure 1

Discussion in Relation to Previous Studies

The findings demonstrate acoustic variation in English vowel productions across the selected speakers and lexical items. This general observation is consistent with previous research examining English vowel production among Indonesian speakers and comparisons between native and non-native speakers. Azzahra et al. (2024) examined English vowel formant characteristics using Praat and identified acoustic differences between native and Indonesian non-native speakers. Similarly, Kurniawan et al. (2024) investigated English vowel production among Indonesian speakers and reported differences in the acoustic realization of selected English vowel categories.

The present study contributes additional descriptive observations by comparing F1 and F2 measurements obtained from three young adult speakers and one native-speaker reference. However, the findings should be interpreted within the specific context of the selected participants and lexical items rather than generalized to broader populations. From an acoustic perspective, F1 is generally associated with vowel height, while F2 reflects the front–back dimension of vowel articulation (Ladefoged & Johnson, 2014). Nevertheless, the interpretation of these relationships depends on accurate vowel segmentation and reliable formant measurements. Although differences across lexical items may be associated with individual speaker characteristics, accent, linguistic experience, and surrounding phonetic environments, the present study does not provide sufficient evidence to establish these factors as direct causes of the observed variation.

Furthermore, differences from a single native-speaker reference do not necessarily indicate inaccurate pronunciation. Therefore, the findings are best understood as descriptive acoustic differences rather than direct assessments of pronunciation correctness.

Methodological Considerations and Limitations

Several methodological limitations should be acknowledged. First, the study involves only three young adult speakers and one native-speaker reference, limiting the generalizability of the findings. Second, several selected words contain multiple vowels or diphthongs, although the study focuses on English monophthong production. The exact vowel segments represented by the reported measurements therefore require clarification. Third, the available dataset does not consistently specify the temporal measurement points used to extract F1 and F2 values. In addition, information about the recording equipment and Praat analysis settings remains incomplete. Finally, the study does not include independent perceptual judgments or validated criteria for determining pronunciation accuracy. Consequently, the findings cannot establish whether the observed acoustic differences represent pronunciation errors.

Despite these limitations, the study provides descriptive information about acoustic variation across the selected speech samples and demonstrates the potential usefulness of Praat for examining and comparing speech measurements. Future studies should employ more systematically controlled vowel materials, clearly identified measurement points, and larger participant samples to strengthen the reliability and interpretation of acoustic findings.

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CONCLUSIONS

This study examined the acoustic characteristics of English vowel production among three young adult speakers and one native English reference speaker using Praat. Analysis of ten selected words revealed variations in first formant (F1) and second formant (F2) frequencies, with fish showing the highest reported values across speakers and notable F2 differences in meat. These findings demonstrate the usefulness of F1 and F2 measurements in describing vowel variation, as F1 relates to vowel height and F2 to vowel frontness and backness. However, the results represent preliminary descriptive observations rather than definitive evidence of pronunciation errors or linguistic influences. Limitations include the small sample size, uncontrolled vowel materials, incomplete identification of vowel segments, and reliance on a single native-speaker reference. Future research should involve more participants, controlled vowel materials, standardized recording procedures, and multiple native-speaker references. Additionally, perceptual assessments could complement acoustic measurements. Further studies should investigate how Praat-based acoustic feedback can support English pronunciation learning and improve learners' awareness of vowel production.

DECLARATION

Author Contributions: All authors contributed to the development of this study according to their respective roles and areas of expertise. Their contributions included research conceptualization, data collection, data analysis, manuscript preparation, and critical review of the final article.

Conflict of Interest: The authors confirm that there are no competing interests or personal relationships that could have influenced the research or the preparation of this manuscript.

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Ethical Approval: The research was conducted in accordance with applicable research procedures, ethical principles, and institutional guidelines. All research activities followed the relevant requirements for responsible academic research.

Use of Generative AI: Generative AI tools were utilized solely to assist with English language-related purposes, including grammar checking, language refinement, and improving the clarity and readability of the manuscript. All research activities, data interpretation, and academic conclusions remain the responsibility of the authors.

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