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Emerging shift and merger: Acoustic analysis in received pronunciation vowel production by Mandar EFL learners

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Abstract

This study aims to investigate differences in the production of received pronunciation vowels /a:/ and /æ/ between Mandar EFL learners and native speakers, as well as the distribution of vowel patterns across participants' academic levels, using a mixed qualitative and quantitative approach. There are 5 words in this current research that contain the initial vowels/a:/ and /æ/: 'afternoon', 'answer', 'apple', 'animal', and 'actor'. To examine the vowel difference, this research used audio recordings from 10 participants: 5 from the 5th semester and 5 from the 1st semester. The audio recordings were analyzed with PRAAT to measure openness using F1 and tongue position using F2. The formant data were then normalized using the Lobanov normalization to avoid confounding by gender, age, and physiological variables. The analysis was conducted to figure out the distinction pattern of vowel articulation by Mandar and native speakers, and the possibility of vowel shift and merger. The results indicate a significant difference in vowel production between Mandar and native speakers, as confirmed by the t-test. The articulatory distinction between a Mandar native speaker and a native speaker is reflected in the articulation of the vowel /æ/ that shifts in all contexts. Meanwhile, the vowel /a:/was articulated differently across contexts by Mandar speakers. The findings showed that Mandar speakers exhibit vowel shifting and merger, which are caused by the assimilation of L2 sounds to L1 and by the quantity-quality of L2 input. Moreover, the results appear to support the SLM-r hypothesis in phonetic formation in L2 acquisition.

Keywords: *Phonetic acoustic analysis, vowel production, vowel shift, vowel merger, L2 acquisition, SLM-r*

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Introduction

The ability of producing sound in L2 acquisition for EFL learners can be very challenging, and numerous factors contribute to this condition. This problem has been studied for decades, and many researchers have found that one factor is the influence of the L1 sound system. According to Odlin (2005) the interference occurred in every dimension of language including the speech sound to syntactic structure. At the level of speech sounds, Weinreich (1957) explained that differences in phoneme inventories, the spelling of a second language, the sociolinguistic factor of wanting to sound native-like, and irregular phenomena such as speech errors are among the factors of phonetic interference. Those factors introduced Weinreich (1957) are not limited to that, because explaining the L2 development might be more complex than we might imagine. Some previous studies show that the L1 effect is difficult to exclude in this context. In some L2 models, L2 success is always correlated with the L1 phonological system. According to Best and Tyler (2007), the phonological system of L1 and L2 converges at the same point that we call “interlanguage”, which means the L1 and L2 systems cannot

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be isolated from each other. In PAM-L2, this model focuses on linguistic experience and theorizes that the inexperienced learner will assimilate L2 sounds to their L1 (Best & Tyler, 2007). In other words, the principle of PAM-L2 uses L1 as fundamental to distinguish the level contrast sound in L2 (Chang, 2019).

Subsequently, L2LP (second language linguistics perception) conducted by Escudero and Yazawa (2024) notes that we should understand the optimal perception in L1 and L2, as each language has a different definition of "optimal" awareness. The researchers believed that the outcomes of the L2 learning process depend primarily on how well the perception of initial conditions is optimized. Therefore, this model posits that acoustic distribution in L2 and the sounds' similarities in L1, including their phonemic and allophonic conditions, are the main concerns to anticipate and clarify L2 development. In this model, phonetic classification is distinguished in 3 ways: similar, new, and subset for L2 learner (Escudero & Yazawa, 2024).

Apart from that, SLM-r by Flege and Bohn (2021) also holds the view that there is a bias from the L1 phonetic system in the L2 speech learning process. However, they bring different premises about L2 speech learning, which focus on the amount of sounds "input" during L2 acquisition. Flege and Bohn (2021) believed that the influence of L1 on L2 perception and production changed as the amount of L2 input increased. However, they noted that in some "special" cases, the L1 effect cannot be used to explain the bilingual perspective. The explanation from various frameworks, which clarifies that interference from L1 cannot be ignored, shows that the L1 system always appears at the first step of L2 learning. As Tyler and Best (2024) said, the native language learners use throughout their lives, and the language they are exposed to during infancy is the language they will use when developing sound perception as adults. However, that situation can sometimes become the main issue in recognizing L2 sounds, particularly when vowels and consonants are unavailable in the L1.

Regarding this, previous research on the interference of L1 in the L2 learning process has been widely conducted across various languages. Byers and Yavas (2017), in the case of English-Spanish, found that there is a difference in spectral qualities of schwa-final position production between monolinguals, early bilinguals, and late bilinguals, resulting in F1 values that differ between early bilinguals and monolinguals. These differences also show in the duration of vowel production, where late bilinguals exhibit significantly longer durations than early bilinguals and monolingual participants. Based on that result, the researcher notes that an important factor contributing to this situation is the age of learners at the onset of L2 acquisition. In different cases reported by Norrman (2024), it was found that even when someone loses contact with their L1 for years, there is always interference in L2 acquisition due to exposure to L1 during early childhood. In his study of Chinese-Swedish, one of the findings reveals that the production of the Swedish vowel /y/ and /ʉ/ differs between adoptee participants and native speakers, especially in their allophone production. The researcher explains that adoptee participants performed the correspondence between [y:] and [ʉ:] in Swedish and [y] in Chinese.

The phonology system of L1 indeed affects the L2 sound-learning process, as was once again demonstrated by a previous study. The study conducted by Eckman and Iverson (2013) reveals that the phonological system of L1 is accidentally transferred into the interlanguage of Japanese and Korean participants when producing the English consonants/s/and/ʃ/.They explained that Japanese participants successfully distinguished those consonants because in their L1, both sounds are contrasted, even though they exhibited hypercorrection. While in Korean the consonant [s]–[ʃ] is an

allophone of /s/, as a result, the Korean participant found it more difficult to contrast those consonants, both in basic and derived environments of words.

It is important to note that English in Indonesia is categorized as EFL (English as a Foreign Language), with most students learning English in a formal classroom setting. Hence, the situation is somewhat different from previous research, as mentioned above, in which participants live and interact with native speakers. In some early investigations, phonological interference in English due to the native language has been a still salient issue in language learning research. Moreover, Indonesia has many local languages with phonological systems that differ from those of either Indonesian or English.

For EFL learners, English phonemes (especially vowels) are somewhat difficult to produce like a native speaker. This is supported by a previous study on EFL learners in second-language acquisition. The study conducted by Yoo (2024) found that Korean EFL learners tend to merge the vowels /i/-/ɪ/, and /e/-/æ/. The same case was also found in Yusuf et al. (2024), which showed that female speakers of Acehnese overlap the vowels/i/-/ɪ/, /ɜː/-/ʌ/, and /ɛ/-/æ/ in their pronunciation. Moreover, the change in the quality of the vowel is also reported by Perwitasari et al. (2016), who found that both Javanese and Sundanese EFL learners articulated the vowel /æ/ closer to the native speakers' realization of /e/. This sort of case of vowel shift and merger also occurs in countries where English has become one of the national languages, such as Canada and Singapore. In Canadian English, there is a term "*Canadian Vowel Shift*" that has been studied over the years, one of which was conducted by Boberg (2019), who found that short front vowels in English, such as /i/, /e/, and /æ/, experience vowel shift consistently, avoiding peripheral positions altogether. In line with that, in Singaporean English, vowels such as /iː/ - /ɪ/, /e/ - /æ/, and/ɔː/ - /ɒ/ are produced very closely together (Deterding, 2003). As previous studies found, we can consider that vowel changes in learners of English as a Foreign Language are among the most common cases. This vowel shift and merger is also likely to appear in this current research, regardless of whether the changing vowel follows the same pattern as in previous studies or not.

In this paper, we will focus on investigating the Received Pronunciation (RP) vowel production by Mandar EFL learners. As explained above, phoneme inventories of L1 now seem urgent to explain, as L1 plays a crucial role in L2 development. Mandar is one of the most widely spoken languages in the Province of Sulawesi Barat. It is mostly spoken in Majene, Polewali Mandar, and some parts of Mamuju. Mandar has only 5 vowels: /i, e, a, o, u/ without allophones. Based on the high-low parameters, the Mandar language has 2 high vowels, 2 mid vowels, and 1 low vowel (Muthalib, 1977; Muthalib et al., 1992; Pelenkahu et al., 1983). Blust (2025) explained that most of the languages in Proto Austronesian have only 4-5 vowels. Hence, we could say that Mandar has a small vowel inventory.

On the other hand, RP has a complex vowel inventory of 20 vowels in total (though this is still debated) (Roach, 2004). It consists of 12 monophthongs (/iː, ɛ, ɑː, ʌ, uː, ʊ, ɜː, æ, ɔː, ɪ, ɒ/) (Hawkins & Midgley, 2005; Hughes, 2013) and 8 diphthongs (Roach, 2004). Over the years, there has been development in the knowledge of RP phonetics system. Upton (2004) said that the vowels in RP are divided into contemporary RP and traditional RP. During the decades, several vowel shifts reflect the characteristics of contemporary speakers. However, some vowels remain unchanged in quality compared to traditional RP. The vowel /æ/ is one of the vowels affected by vowel shift. Bjelaković (2017) argues the same thing through formant-value measurements, which show a decrease in the quality of TRAP vowels, leading them to be classified as/a/. Lindsey and Wells (2019) also stated that,

currently, TRAP vowels are more prominent as /a/than as/æ/. However, in this study, we retain the use of the phonetic symbol /æ/ due to considerations of comparative analysis with the study by Hawkins and Midgley (2005), which also uses/æ/ even though the quality of the vowel in their study related to newest research.

The typological differences between Mandar (L1) and RP (L2) are the focus of this research. Based on previous studies, our goal is to provide a more comprehensive explanation of Received Pronunciation vowel production by L2 learners with wide vowel inventory contrasts relative to RP through phonetic-acoustic analysis. With the focus of this research, we attempt to explore how RP vowels are realized by Mandar EFL learners based on the phonetic formation categories in SLM-r (Flege & Bohn, 2021) which aims to see the stage of L2 acquisition of Mandar EFL learners through vowel production.

Moreover, since many studies have already examined the age at which to start learning L2, this research will investigate this issue from another perspective: the university academic level because we want to explore more about different exposure of L2 input. As mentioned in SLM-r (Flege & Bohn, 2021), the quality and statistics of L2 input play a significant role in L2 acquisition. In a previous study, bilingual Catalan-Spanish speakers in Majorca showed greater ability to contrast the Catalan mid vowel than bilingual speakers in Barcelona. The researcher argues that Catalan exposure in Barcelona is more varied and influenced by Spanish, whereas in Majorca it is more homogeneous (Amengual, 2016). Hence, pronunciation ability may be influenced by academic level since it reflects differences in exposure. It can be hypothesized that learners at higher academic levels receive more L2 input than first-year students, suggesting that higher academic levels might be easier to contrast differences in phonetic sounds. However, it should be noted that academic level is not the only determining factor, as the pronunciation capabilities of the speakers are also influenced by the quality of input and the availability of explicit phonetic training. Nevertheless, we restrict this research to the academic level because we lacked information on the quality of input that students receive.

This study will discuss only the vowels /ɑː/ and /æ/, which are considered similar to the vowel /a/ in the Mandar language. Regarding the vowel quality in RP, the vowel /æ/shows the closest features to the low-mid vowel /a/ in Mandar. Nevertheless, this vowel is not available in the Mandar vowel system. Regarding the above explanation, this study formulates 2 research questions: (1) Do Mandar EFL learners articulate the vowel /ɑː/ and /æ/ contrastively from the received pronunciation speakers? (2) Does the academic level of Mandar EFL learners affect the proficiency in producing the RP vowel /ɑː/ and /æ/?. In line with those research questions, the current study also brings two hypotheses. First, the vowel /æ/ will be produced more easily than the vowel /ɑː/. Second, participants with higher academic backgrounds will find it easier to produce vowels than first-year students, as we expected that participants with higher levels would be more proficient in English.

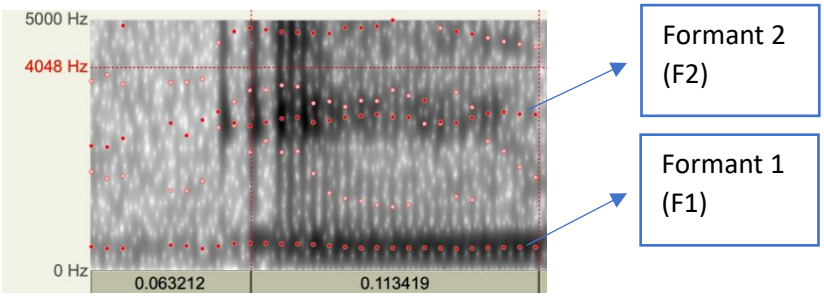
Method

Ten students (18 – 21 years old) from the English Language Education Major at same university in Majene participate in this research, comprising two academic levels: 1st semester (5 participants) and 5th semester (5 participants). In this research, the term “high-level students” referred to students in the 5th semester, and “freshman” to students in the 1st semester. Due to unequal numbers of students across genders, we decided to include all females as participants, as they are the majority in each class.

It is important to note that the academic level at university cannot be equated with the value of their proficiency. However, almost none of the students had taken an English proficiency test, such as TOEFL, IELTS, or others. All participants were informed of the background, purposes, and implications of this research and filled out the consent form to join as participants.

As this article concerns vowel production, we used a reading-sentence control, as previous researchers have done. The control sentence we used here is "I want to say _" with the blank space for the key words of each vowel. Unlike previous studies, the stimulus words used here have an initial vowel to avoid the effect of the preceding sound. The words we used were "afternoon, answer, apple, animal" which the words represent the vowel /ɑː/ and /æ/. Moreover, we also add one additional word that is "actor" as control words.

Figure 1. Spectrogram of PRAAT 6.2.22 (Boersma & Weenink, 2022)



Since the number of participants is relatively small, this study is used the mix qualitative and quantitative approaches. Therefore, this study designed as an exploratory investigation to provide preliminary findings on the distribution patterns of the vowels /ɑː/ and /æ/ produced by Mandar EFL learners, with details of the phonetic-acoustic analysis. In light of this limitation, during data collection, each participant was instructed to read each sentence (with key words highlighted) twice. In total, we have 100 tokens. Due to the audio recording's quality, only 92 tokens were used in the current research. As part of a phonetic-acoustic research analysis, we used PRAAT (Boersma & Weenink, 2022) to extract the formant values for each token.

In this research, only F1 and F2 were taken for this analysis. The F1 and F2 values were determined through stable frequency or mid-point of vowel in PRAAT (Boersma & Weenink, 2022) in order to avoid the co-articulation effect by the following consonant. Therefore, the formant values are derived from the formant listing feature. Due to poor audio quality in certain areas, manual analysis is required. The analysis was performed using the most stable spectrogram frequency, without looking at the formant listing feature. The F1 and F2 data from PRAAT were then normalized using Lobanov's method (Lobanov, 1971) and scaled to Hertz using the NORM website (https://lingtools.uoregon.edu/norm) (Thomas & Kendall, 2007) to remove the gender, age, and physiological differences variables that might have influenced the vowel realization. This current research used Lobanov normalization because it is one of the best methods to normalize the vowel by maintaining the phonemic and sociolinguistic variation, but it can still reduce other variables such as gender, age, and anatomical problems (Adank et al., 2004). All F1 and F2 data are imported into Excel to calculate the average value of each vowel and to perform a t-test. This current research performed the independent-sample t-test to measure the degree of difference between two groups.

To equalize data collection between Mandar speakers and Received Pronunciation speakers, we aim to use the same data-collection process. The formant values of the RP native speaker were taken from the young group in Hawkins & Midgley (2005), who were aged 20-25 at the time of data

collection; this age range is similar to that of Mandar speakers in this research. An additional reason we used the data from Hawkins & Midgley (2005) as a standard is the availability of complete data that are almost identical to MS, such as age range, number of speakers, and number of tokens. In Hawkins & Midgley (2005), each participant seems repeat the words several times. However, in this research, we only obtained the first and second extractions of F1 and F2 from their data to match the data we have here.

Results and Discussion

The findings presented below are divided into two parts: results and discussion. First, the results begin to explain the vowel movement in the F1-F2 space in terms of formant values. Then, we explained the difference in vowel quality between MS and NS based on the t-test result. Second, the discussion begins to explain the pattern of vowel shift and merger by MS during vowel realization. In this part, we also elaborate on the probable factors that cause the vowel change in MS articulation.

The frequency differences of vowel /ɑː/ and /æ/ between Mandar and Received Pronunciation speakers

Vowel This section presents the results of F1 and F2 measurements of the vowels/ɑː/ and /æ/ produced by Mandar speakers (MS) with different academic levels, and compares them with NS formant realizations. Table 1 below presents the average F1 and F2 values for each vowel across different word contexts. All the data in Table 1 are plotted in the vowel space in Figure 2 to show the exact positions of each vowel across different contexts.

Table 1. The average of F1 and F2 values of vowel /ɑː/ and /æ/ (Lobanov normalized)

Vowel	Words	High-Level Students (5th Semester)		Freshman Students (1st Semester)		Vowel	RP Native Speakers (Hawkins & Midgley, 2005)	
		F1 (Hz)	F2 (Hz)	F1 (Hz)	F2 (Hz)		F1 (Hz)	F2 (Hz)
/ɑː/	Afternoon	644	1060	696	992	/ɑː/	494	1245
/ɑː/	Answer	539	1292	465	1371	/æ/	671	1540
/æ/	Apple	317	1963	378	1861			
/æ/	Animal	411	1997	392	1996			
/æ/	Actor	526	1523	506	1610			

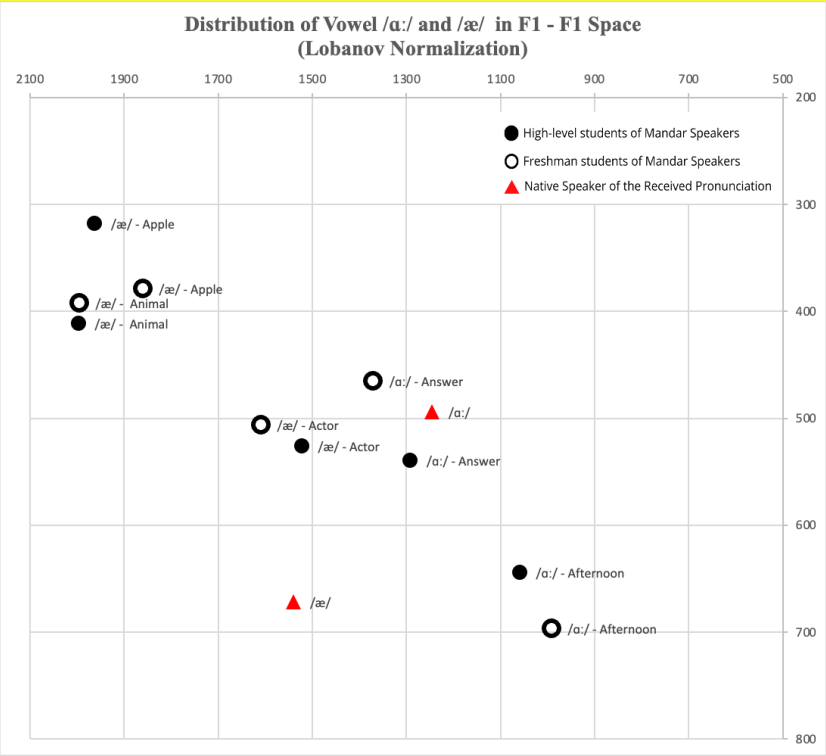
The result revealed an important pattern in the vowel distribution of /ɑː/ and /æ/ produced by MS. It should be noted that vowel quality can be indicated by at least 3 features: height, backness, and rounding (Hayes, 2010)However, for this research, the rounded features are excluded because all the vowels analyzed here were categorized as unrounded. The F1 value measures the degree of openness, also known as vowel height. The F2 value is used to measure the position of the tongue (backness) to distinguish front, mid, and back vowels.

As shown in Table 1, MS has a high F1 and a low F2 compared to NS in the realization of vowel /ɑː/ in the 'afternoon'. This indicates that MS articulates the vowel /ɑː/ in the 'afternoon' with a more open

vowel, while the tongue position is posterior to the NS realization. The open /a:/ in MS realization appears to have the same quality in the degree of openness as the vowel /æ/ articulated by NS (see figure 2). This implies the same range value in F1 of vowel /ɑ:/ in the 'afternoon' produced by MS and vowel /æ/ generated by NS.

However, this result contradicts MS's realization of the vowel /ɑ:/ in 'answer', as shown in Figure 1. Based on the F1 and F2 value, the vowel /ɑ:/ in 'answer' does not show a larger acoustic distance to NS articulation in vowel /ɑ:/, indicating the vowel /ɑ:/ in 'answer' is articulated closer to NS. This result supported by independent t-test in F1 and F2 revealed that high level students and freshman articulatory of vowel /ɑ:/ in 'answer' compared to vowel /ɑ:/ in NS show p value greater than 0,05 indicates that the differences is not statistically significant (p value of high level students and NS show F1 = 0,30, F2 = 0,25, while p value of freshman students and NS indicate the F1 = 0,60 and F2 = 0,11).

Figure 2. The distribution of vowel /ɑ:/ and /æ/ in F2 – F1 space



In the vowel /æ/, MS demonstrated a larger acoustic distance in formant values than NS. In Table 1, the vowel /æ/ in the context of 'apple' and 'animal' had low F1 and high F2 values, indicating this vowel is consistently articulated more closed and fronted than the NS realization. However, the vowel /æ/ in actor is articulated lower and more centralized than in 'apple' and 'animal'. From Figure 1, the vowel /æ/ in actor produced by MS is pronounced closer to vowel /ɑ:/ rather than /æ/ generated by NS.

In terms of academic level, vowel distribution between high-level students and freshmen does not reflect significant differences in their realization, except for the F1 value of the vowel /ɑ:/ in the 'afternoon', which shows a p-value at the significance threshold of 0,05 (see table 2). However, the F2 value between high-level students and freshmen has p = 0,4, indicating that there are no meaningful

differences. This revealed that high-level students and freshmen differ in the degree of openness. However, tongue position does not indicate a significant distinction in the realization of the vowel /ɑː/ in the 'afternoon'. As shown in Table 2, the vowel /ɑː/ in 'answer' has p-values higher than 0,05 for the F1 (p = 0,28) and F2 (p = 0,47). These indicate that high-level students show no significant differences in vowel height or tongue position features. In line with it, the p-value in independent t-test results of vowel /æ/ for 'apple', 'animal', and 'actor' also provides no evidence of a difference in high-level students and freshman vowel realization because the F1 and F2 exhibit a p-value greater than 0,05. This revealed that high-level students and freshmen have equivalent vowel-quality production.

Table 2. Independent t-test results of high-level students and freshman vowel

Words	Vowel	Variables	group	P value *
Afternoon	/ɑː/	F1	High-level students Freshman	0,05
		F2	High-level students Freshman	0,4
Answer	/ɑː/	F1	High-level students Freshman	0,28
		F2	High-level students Freshman	0,47
Apple	/æ/	F1	High-level students Freshman	0,2
		F2	High-level students Freshman	0,3
Animal	/æ/	F1	High-level students Freshman	0,7
		F2	High-level students Freshman	0,9
Actor	/æ/	F1	High-level students Freshman	0,6
		F2	High-level students Freshman	0,5

***p < 0,05, indicates significant**

These findings show that the vowels /ɑː/ in 'afternoon' and /æ/ in 'apple', 'animal', and 'actor' shift in the F1-F2 space to different positions compared to NS. Moreover, the vowel /æ/ in 'actor' also exhibits a merger with the vowel /ɑː/ in NS realization. Meanwhile, the vowel /ɑː/ in 'answer' has similar articulation with NS.

Vowel shifting and merger by Mandar speakers through Realization of /ɑː/ and /æ/

The shift vowel that occurs in the realization of /æ/ and /ɑː/ might shift towards to another vowel quality because the effect of L1 phonological system, which according to Muthalib et al. (1992) Mandar language only have 5 vowels that are /i, e, a, o, u/ and the vowel /æ/ and /ɑː/ does not exist in Mandar vowel system. From an L2 acquisition perspective, the absence of a particular vowel in L1 can make the L2 learners develop a perception to produce the RP vowel with a similar sound that occurs in L1.

As said in SLM-r, Flege and Bohn (2021) stated that L2 sounds are automatically mapped into L1 by the learner. They elaborated that the greater the dissimilarity in the phonetic sounds between L1 and L2, the easier it will be to distinguish them. The vowel shift of/æ/ in all contexts and of/ɑː/ in 'afternoon' suggests that both sounds are probably perceived as similar to the vowels in the Mandar vowel system, causing the realizations to shift in a different direction from the NS realizations. However, it cannot be determined which specific L1 vowel category /æ/ and /ɑː/ are assimilated to, as this study lacks of L1 phonetic data for comparison.

According to SLM-r (Flege & Bohn, 2021), the development of new formation in the L2 phonetic category progresses through three phases: phonetic awareness between L2-L1, equivalence class, where the sound in L2 is still categorized as the closer sound in L1, and finally, in the last phase, the learner succeeds in building a new form of the L2 phonetic. In this last phase, the learner has distinguished the sound from the L1 and L2. Based on these phases, the perception and production of vowel /ae/ produced by MS is probably still entirely within the equivalence class where the L2 sound is still assimilated to a similar sound in L1. The case of vowel shift in Mandar realization is agreed with SLM-r that the new phonetic category will not form if learners still perceive the L2 sound as too similar to L1 sounds (Flege & Bohn, 2021).These findings are supported by a previous study by Dimitriou (2024) which stated that if there is a correspondence between the sounds in L1 and L2, EFL learners will find it difficult to avoid the use of L1 sounds in L2 acquisition. This situation is familiar when someone learns a new language, as Odlin (2005) called it, interlingual identification, in which learners map the same sounds between the L1 and L2. Odlin (1989) explained that the learner might treat the "similar" sounds in L1 and L2 as "cognate" forms, leading the learner to develop a correspondence between those sounds during the interlingual stage.

Contrastively, the MS learner succeeded in building a new L2 phonetic category for vowel /ɑː/ in 'answer' despite failing in the production of vowel /ɑː/ in the 'afternoon'. Based on the SLM-r model (Flege & Bohn, 2021), this condition suggests that MS stands in the initial phase of delinking the L1 sound in L2 acquisition for the vowel /ɑː/ realization because MS can already produce the sound of vowel /ɑː/ like a native. This finding is in line with a previous study, which found that EFL learners in Korea have high accuracy with similar vowels in their L1, for example, /u/ and /ɪ/. Meanwhile, they tend to be less accurate with unfamiliar vowels, such as/ɑ/. The researchers stated that the degree of accuracy in sound perception is not always calculated from acoustic distance between L1 and L2 (Lee & Baek, 2025).

The ability of MS to produce /ɑː/ (in 'answer') but failure to produce the vowel /æ/ aligning with previous findings from Al Abdely (2021) revealed that the RP vowel /ɑː/ is easier to produce, while the vowels such as /æ/, /ɒ/, and /ʌ/ encountered difficulties for Iraqi EFL learners. He explained that the reason for those conditions is that Iraqi EFL learners more easily distinguish the durational cues than the spectral cues. He elaborated that in the interlingual stage, the difficulties for EFL learners to articulate the low RP vowel are because those vowels are close to each other, leading EFL learners to have problems in vowel identification. Indeed, the vowel /ɑː/ and /æ/ in RP is classify as low vowel which in general the difference is distinguished based on the tongue position.

Furthermore, the vowel shift as it occurs in all contexts of vowel /æ/ and the vowel /ɑː/ in the 'afternoon' produced by MS is not only based on L1 influence. In this study, the hypothesis that

exposure to L2 input differs by academic level was not supported, as the results showed that the vowels /ɑː/ and /æ/ produced by MS had the same distribution pattern. This result suggests the possibility of a lack of quality of input during L2, as mentioned in SLM-r (Flege & Bohn, 2021). Byers and Yavas (2017) explained that the quality of phonological input, the length of language learning, and the bilingual teacher also affect proficiency in producing L2 sounds. Flege and Bohn (2021) emphasized that not only the quantity of input but also the quality of input given to learners needs to be considered to form a new phonetic category. In a previous study, Kučerová and Šimáčková (2025) demonstrated that input quality influences children's ability to differentiate between the L2 vowels /æ/ and /ɛ/ through a longitudinal study. Their findings revealed that the old vowels learned at home differed from the new vowels taught through good teacher-produced input, making vowels /æ/ and /ɛ/ distinguishable. However, the old vowels taught at home still exhibit overlap due to the heterogeneity of L2 input, which comes from parents who experienced mergers of the vowels/æ/ and /ɛ/, and from appropriate teacher production, which makes the children confused because of the difference in input at the same time. This previous study has shown that the sociolinguistic factor must also support input quality, as variation in sounds input affects how the learner produces sounds.

Moreover, the effects of L2 use in environments that do not yet use English extensively, in this case, where participants still live in their first-language environment, can also lead to difficulties distinguishing similar sounds between L2 and L1 due to language contact. Previous research has found that vowel mergers and shifts in Singapore English occur because English is still in contact with other languages used in Singapore, such as Hokkien, Malay, and Tamil (Deterding, 2007; Imatufariq et al., 2022).

Subsequently, the presence of vowel merger in the realization of vowel /æ/ by MS and vowel /ɑː/ generated by NS, might be caused by the grapheme effect. According to previous study stated the participant in their research experienced greater difficulty spelling vowel digraphs than consonant digraphs due to the correspondence between graphemes and phonemes (Sammour-Shehadeh et al., 2025). Hence, we cannot exclude the possibility that the perceptual and production divergence in English vowels results from inconsistent grapheme-phoneme correspondences, making it difficult for EFL learners to contrast or conflate the quality of the same vowel. While in Mandar, the vowel sounds are coherent with their grapheme in every position in words. Moreover, this recent study used the instrument words with initial with grapheme <a> that probably makes learners confused in distinguishing the vowels in each word that we tested for this research. In the study conducted by Fabra (2022) with Spanish-Catalan EFL learners found that the reading test for articulation needs more attention, as learners map graphemes to specific phonemes. As a consequence, the Spanish-Catalan EFL learners cannot block the L1 influence on pronunciation of unfamiliar words, which causes the pronunciation error. In line with the findings, the vowel merger of/æ/ by MS with /ɑː/ articulated by NS is attributed to difficulties in mapping the grapheme to the phonetic sound, due to confusion in the words we tested.

Conclusion

In conclusion, MS shows a different realization of the vowel /æ/ in all word contexts tested, while for the vowel /ɑː/, it is partially different from NS due to the shift vowel in 'afternoon'. Additionally, participants' academic levels showed no significant differences in vowel production, suggesting a similar pattern of L2 phonetic processing and contradicting the early hypothesis. The dominance of the

shift vowel seems to support the idea in SLM-r of the assimilation of sound caused by the influence of L1, quantity, and quality of input of L2 towards the attainment of vowel production in L2 acquisition.

Moreover, the MS realizations have the same pattern in the degree of openness for each vowel. All vowels /æ/ are articulated with closer lips than the vowels generated by NS. Meanwhile, the /ɑː/ in 'afternoon' is produced with more open lips. The consistency of inaccurate direction in the MS degree of openness, as seen in the F1 value of each vowel, should get more attention for Mandar EFL learners. Pedagogically, these findings highlight that Mandar EFL learners need to train their pronunciation, especially in the degree of openness to contrastive vowels in L2. It is recommended that pronunciation training use words containing a vowel from minimal pairs in English to ensure accurate production. Moreover, this training can help develop perceptions of English vowels among Mandar ELF learners.

However, we acknowledge that a small sample size still limits this study and that it lacks L1 phonetic data to examine differences in vowel realizations. This circumstance may influence the explanation of the findings due to data limitations. Therefore, further research on English vowels produced by Mandar EFL learners is still needed, using a larger dataset, to provide more specific explanations in phonetic-acoustic terms. Moreover, future research also needs to examine phonetic-acoustic analysis of the Mandar vowel system to establish a scientific correlation between L2 and L1 sounds.

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