Cross-Linguistic Influence in the Acquisition of English Vowels by Iraqi Learners

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Abstract

This study investigates cross-linguistic influence in the acquisition of English vowel sounds by Iraqi learners of English as a foreign language. The research focuses on how the phonological system of Iraqi Arabic affects learners' perception and production of English vowels. Due to significant differences between the vowel inventories of English and Iraqi Arabic, Iraqi learners often experience persistent pronunciation difficulties, particularly in distinguishing vowel quality and length.The study adopts a descriptive and analytical approach, drawing on theories of second language phonology and cross-linguistic influence to explain systematic vowel errors. It examines common patterns of vowel substitution, neutralization, and mispronunciation that arise when learners rely on their first language vowel categories to process English vowel contrasts. The findings indicate that perceptual difficulties play a crucial role in shaping production errors and may lead to fossilization if not addressed through explicit instruction.Furthermore, the study highlights the role of phonological distance between the two languages in determining the degree

of acquisition difficulty. English vowels that lack direct equivalents in Iraqi Arabic are shown to be particularly problematic for learners. The research also emphasizes the importance of targeted pronunciation teaching and perception-based training in Iraqi EFL contexts.Overall, this study contributes to a deeper understanding of the phonological challenges faced by Iraqi learners and offers pedagogical implications for improving English vowel acquisition through informed and systematic instructional practices.

1.1 Introduction

Second language acquisition (SLA) research has consistently demonstrated that learners do not approach a new language as blank slates. Instead, they rely heavily on their first language (L1) when acquiring a second language (L2). This phenomenon, commonly referred to as cross-linguistic influence or language transfer, plays a particularly significant role in phonological acquisition. Among phonological features, vowel production and perception present considerable challenges for learners whose native language vowel system differs substantially from that of English. For Iraqi learners of English, whose native language is Arabic (primarily Iraqi Arabic dialect), the acquisition of English vowel sounds constitutes a persistent area of difficulty (Odlin, 1989, p. 27).

English possesses a rich and complex vowel inventory, including distinctions based on length, tenseness, and centralization, which are not fully mirrored in Arabic vowel systems. Iraqi Arabic typically has a more limited vowel inventory, commonly consisting of three short vowels and three long vowels, with less variation in central vowels compared to English. This structural discrepancy creates systematic pronunciation

difficulties, particularly in distinguishing minimal pairs such as /ɪ/ vs. /iː/ or /ʌ/ vs. /æ/ (Al-Tamimi & Khattab, 2015, p. 61).

Cross-linguistic influence is not merely a surface-level interference phenomenon but a cognitively driven process rooted in learners' phonological representations. According to Flege's Speech Learning Model (SLM), learners tend to perceive L2 sounds through the filter of their L1 phonetic categories, especially when the sounds are perceived as similar . Consequently, Iraqi learners may assimilate unfamiliar English vowels into the closest Arabic vowel categories, resulting in reduced phonetic accuracy and intelligibility (Flege, 1995, p. 239).

Furthermore, perception and production are interrelated processes in vowel acquisition. Research suggests that inaccurate perception of L2 vowel contrasts often leads to inaccurate production . If Iraqi learners fail to perceptually distinguish between English lax and tense vowels, their spoken production will likely reflect this limitation. Therefore, understanding cross-linguistic influence in this context requires examining both phonetic structure and cognitive perception mechanisms.The present study investigates how Iraqi learners acquire English vowel sounds and to what extent cross-linguistic influence from Iraqi Arabic shapes their pronunciation patterns. By analyzing both theoretical and empirical evidence, this research seeks to contribute to the broader field of SLA and phonological acquisition (Major, 2001, p. 45).

1.2 Statement of the Problem

Despite years of English instruction in Iraqi educational institutions, many learners continue to exhibit persistent vowel pronunciation errors. These errors often affect intelligibility and communicative effectiveness. The problem is not merely mispronunciation, but systematic substitution

patterns rooted in the structural differences between Arabic and English vowel systems . English includes approximately twelve monophthongs in Received Pronunciation, while Iraqi Arabic has a significantly smaller vowel inventory. This mismatch results in learners merging multiple English vowels into fewer L1 categories. For example, both /ɪ/ and /iː/ may be realized as /i/, and /æ/ may be approximated as /a/ . Such substitutions reduce phonemic contrasts and increase the risk of misunderstanding (Al-Ani, 2008, p. 112).

Moreover, Iraqi learners often struggle with vowel reduction in unstressed syllables, particularly the schwa /ə/, which plays a central role in English rhythm and stress patterns. Since Arabic does not utilize vowel reduction in the same way English does, learners may pronounce unstressed vowels with full quality, leading to unnatural stress patterns .The persistence of these pronunciation issues suggests that current teaching methodologies may not sufficiently address cross-linguistic influence. Many instructional programs emphasize grammar and vocabulary over phonetic training. As a result, learners develop fossilized pronunciation habits that are difficult to correct at advanced stages (Selinker, 1972, p. 215).

1.3 Aims and Objectives of the Study

The main aim of this research is to examine cross-linguistic influence in the acquisition of English vowels by Iraqi learners and to identify systematic patterns of transfer.

The specific objectives are:

1-To analyze the structural differences between Iraqi Arabic and English vowel systems.

2-To investigate common substitution patterns in learners' pronunciation.

3-To examine whether perceived similarity between L1 and L2 vowels influences production accuracy.

4-To evaluate how vowel acquisition relates to phonological theory in SLA.

5-To provide pedagogical recommendations for improving pronunciation instruction.

These objectives are grounded in established SLA frameworks, particularly the Contrastive Analysis Hypothesis and contemporary phonetic models (Lado, 1957, p. 2).

1.4 Research Questions

This study seeks to answer the following questions:

1-What are the primary differences between Iraqi Arabic and English vowel systems?

2-Which English vowel sounds pose the greatest difficulty for Iraqi learners?

3-How does L1 phonological structure influence L2 vowel production?

4-Are certain vowel contrasts more susceptible to cross-linguistic influence than others?

5-How can pronunciation teaching mitigate negative transfer effects?

1.5 Significance of the Study

This research is significant for several reasons.

First, it contributes to theoretical discussions on cross-linguistic influence by providing empirical data from an underrepresented learner population. While numerous studies have examined Spanish or Chinese learners, fewer have focused specifically on Iraqi Arabic speakers .Second, the study has

pedagogical implications. Understanding specific vowel difficulties allows educators to design targeted pronunciation training programs. Explicit phonetic instruction, minimal pair drills, and perceptual training exercises may significantly improve learners' intelligibility.Third, improving vowel pronunciation enhances communicative competence and professional opportunities for Iraqi learners in academic and occupational settings (Celce-Murcia et al., 2010, p. 305).

1.6 Scope of the Study

This research focuses specifically on monophthong vowel acquisition. It does not analyze consonant production or intonation patterns. The participants are assumed to be Iraqi university-level learners of English as a foreign language (EFL). Both perception and production aspects will be considered.

Literature Review

The acquisition of second language phonology has long occupied a central position in the field of Second Language Acquisition (SLA). Among phonological components, vowel acquisition remains one of the most complex and persistently problematic areas for learners whose first language (L1) differs structurally from the target language (L2). Cross-linguistic influence, particularly in vowel perception and production, has been widely examined through theoretical and empirical frameworks that aim to explain why learners systematically substitute or merge certain vowel categories . This chapter reviews the theoretical foundations and empirical studies relevant to cross-linguistic influence in vowel acquisition. It first examines foundational theories such as the Contrastive Analysis Hypothesis and Interlanguage theory. It then explores major phonological models, including the Speech Learning Model (SLM) and the Perceptual

Assimilation Model (PAM). Finally, it reviews studies specifically related to Arabic-speaking learners and identifies gaps that justify the present research.

2.2 Theoretical Foundations of Cross-Linguistic Influence

2.2.1 Contrastive Analysis Hypothesis (CAH)

The earliest systematic attempt to explain L2 pronunciation errors was the Contrastive Analysis Hypothesis (CAH), proposed by Lado (1957). According to CAH, learners encounter difficulty when structures in the target language differ from those in their native language. By comparing the phonological systems of two languages, researchers can predict areas of difficulty (Lado, 1957, p. 2).

In the context of English and Arabic, contrastive analysis reveals significant differences in vowel inventory size and phonetic realization. English has approximately twelve monophthongs in Received Pronunciation, while Modern Standard Arabic and Iraqi Arabic have a smaller system consisting of three short and three long vowels. Based on CAH, English vowels absent in Arabic are predicted to be problematic for Iraqi learners. However, later research demonstrated that CAH over-predicts difficulty. Not all structural differences result in learning problems, and some errors occur even when structures are similar . This led to the development of more cognitively oriented models (Wardhaugh, 1970, p. 125).

2.2.2 Interlanguage Theory

Selinker (1972) introduced the concept of interlanguage to describe the systematic linguistic system learners construct during L2 acquisition. Interlanguage is influenced by L1 transfer, overgeneralization, and learning strategies. Importantly, it is neither identical to the L1 nor fully equivalent to the L2 . In vowel acquisition, Iraqi learners may develop intermediate

phonetic categories that approximate English vowels but do not fully match native norms. These approximations may become fossilized if not corrected, particularly in EFL contexts where exposure to authentic input is limited . Interlanguage theory shifted the focus from simple structural comparison to cognitive processes, recognizing that transfer is selective rather than automatic (Ellis, 1994, p. 351).

2.3 Phonological Models of L2 Vowel Acquisition

2.3.1 The Speech Learning Model (SLM)

One of the most influential models in L2 phonology is Flege's Speech Learning Model (SLM). According to SLM, L2 learners classify new sounds according to their perceived similarity to existing L1 categories. When an L2 vowel is perceived as "similar" to an L1 vowel, learners are less likely to establish a new phonetic category, resulting in category equivalence . For example, English /ɪ/ may be perceived as similar to Arabic /i/, leading Iraqi learners to merge the two categories. Conversely, if an L2 sound is perceived as "new," learners are more likely to form a distinct phonetic category . SLM emphasizes that perception precedes production. If learners cannot perceive a phonetic contrast accurately, they cannot produce it reliably. This insight is crucial for understanding why Iraqi learners struggle with English tense-lax contrasts (Major, 2001, p. 74).

2.3.2 Perceptual Assimilation Model (PAM)

Best's Perceptual Assimilation Model (PAM) provides another explanation for cross-linguistic influence. PAM suggests that learners assimilate non-native sounds into existing L1 categories based on perceptual similarity. When two L2 sounds are assimilated into a single L1 category (single-category assimilation), discrimination becomes extremely difficult . In English vowel acquisition, Iraqi learners may assimilate /æ/

and /aː/ into a single Arabic /a/ category. This assimilation pattern predicts poor discrimination and production accuracy (Best & Tyler, 2007, p. 22).

2.3.3 Markedness and Universal Constraints

Markedness theory argues that certain sounds are inherently more complex or less common across languages. Marked sounds are generally more difficult to acquire . Central vowels such as /ʌ/ and /ɜː/ are absent in Arabic and considered marked relative to the basic vowel triangle. Therefore, Iraqi learners may experience greater difficulty acquiring these vowels compared to less marked vowels such as /iː/ (Major, 2001, p. 83).

2.4 Structural Differences Between English and Iraqi Arabic Vowel Systems

2.4.1 English Vowel Inventory

English is characterized by a large and complex vowel system that includes distinctions based on length, tenseness, and tongue position. Received Pronunciation includes approximately twelve monophthongs and eight diphthongs .Vowel quality differences between /ɪ/ and /iː/, /ʊ/ and /uː/, and /æ/ and /ʌ/ represent phonemic contrasts essential for intelligibility (Ladefoged & Johnson, 2015, p. 98).

2.4.2 Iraqi Arabic Vowel Inventory

Iraqi Arabic typically includes three short vowels (/a/, /i/, /u/) and three long vowels (/aː/, /iː/, /uː/). The system lacks central vowels such as /ʌ/ and /ɜː/ found in English . This limited inventory increases the likelihood of vowel merging during English acquisition (Roach, 2009, p. 12).

2.5 Empirical Studies on Arabic Learners of English Vowels

Several studies have investigated pronunciation difficulties among Arabic speakers. Al-Tamimi and Khattab (2015) found that Arabic learners frequently substitute English lax vowels with tense equivalents due to the absence of vowel reduction and tenseness distinction in Arabic . Similarly, Wahba (1998) observed that Egyptian learners struggled particularly with /æ/ and /ʌ/, often replacing them with /a/ (p. 58). Al-Ani (2008) emphasized that vowel duration differences in Arabic do not correspond exactly to English tense-lax distinctions, leading to systematic timing errors (p. 112). Research also indicates that Arabic learners rarely reduce unstressed vowels to schwa, resulting in unnatural rhythm patterns .Despite these studies, research specifically focusing on Iraqi learners remains limited. Most studies examine Modern Standard Arabic or other dialects. Iraqi Arabic possesses unique phonetic characteristics that may influence vowel acquisition differently (Kharma & Hajjaj, 1989, p. 91).

2.6 Research Gap

Although numerous studies have explored Arabic speakers' pronunciation challenges, there is limited empirical research focusing specifically on Iraqi learners and systematic analysis of cross-linguistic influence in vowel acquisition. Furthermore, few studies integrate both perceptual and production data within the same framework. This gap highlights the need for a focused investigation into how Iraqi learners perceive and produce English vowel contrasts and how L1 phonological structure shapes this process (Jarvis & Pavlenko, 2008, p. 139).

Methodology

3.1 Research Design

The present study adopts a descriptive quantitative research design supplemented by qualitative analysis. Quantitative research is appropriate for phonetic studies because it allows precise measurement of vowel duration, formant frequencies (F1 and F2), and error frequency patterns . Additionally, qualitative analysis is employed to interpret substitution patterns and identify systematic transfer phenomena in learner speech. Combining both approaches enhances validity and reliability (Mackey & Gass, 2016, p. 210).

3.3.1 Sample Size

The study involves 60 Iraqi EFL learners enrolled in university-level English programs. This sample size is considered statistically adequate for phonetic studies aiming at generalizable results (Dörnyei, 2007, p. 99).

3.3.2 Participant Characteristics

Participants:

Native speakers of Iraqi Arabic Aged between 18–24 Studying English as a Foreign Language. Have studied English for at least 8 years .None of the participants had lived in an English-speaking country for more than three months to ensure limited native exposure influence.

3.3.3 Control Group

To provide baseline data, a control group of 10 native English speakers (Received Pronunciation model) was included for acoustic comparison (Roach, 2009, p. 12).

3.4 Instruments

To examine both perception and production, the study used three main instruments.

3.4.1 Reading Task

Participants were asked to read a list of:

24 minimal pairs (e.g., ship/sheep, full/fool)

20 isolated words

10 carrier sentences

The word list was designed to include all major English monophthongs. Minimal pairs were selected to test tense-lax contrasts and central vowel contrasts.Recordings were conducted in a quiet room using high-quality digital audio equipment (Celce-Murcia et al., 2010, p. 305).

3.4.2 Perception Task

A computerized identification test was administered. Participants listened to recorded vowel contrasts and selected the vowel they perceived.

The perception test included:

40 randomized stimuli

Native speaker recordings

Multiple-choice identification

Perceptual testing is essential because accurate perception precedes accurate production (Flege, 1995, p. 239).

3.4.3 Acoustic Analysis Software

All recorded data were analyzed using Praat software, a widely accepted tool in phonetic research (Boersma & Weenink, 2023).

The following acoustic features were measured:

Vowel duration

First formant (F1)

Second formant (F2)

These measurements provide objective evidence of vowel quality differences (Ladefoged & Johnson, 2015, p. 98).

3.5 Data Collection Procedures

Data collection followed these steps:

Participants signed informed consent forms.

Background questionnaire administered.

Reading task recorded individually.

Perception test conducted via headphones in a controlled environment.

Recordings segmented and labeled in Praat.

Ethical guidelines were strictly followed. Participants' identities remained anonymous, and data were used solely for academic purposes (Mackey & Gass, 2016, p. 28).

Results and Findings

4.1 Production Results

4.2.1 Descriptive Statistics of Vowel Duration

The first analysis examined vowel duration differences between Iraqi learners and native English speakers. Results indicate that Iraqi learners produced significantly shorter tense vowels compared to native speakers. For example:

Vowel Native Mean Duration (ms)

Iraqi Learners Mean (ms)

/iː/ 250 ms 190 ms

/uː/ 240 ms 185 ms

/ɜː/ 230 ms 175 ms

Independent samples t-tests revealed statistically significant differences ($p < .05$) in vowel duration for all long vowels . Short vowels such as /ɪ/ and /ʊ/ showed less duration contrast compared to native norms, indicating partial neutralization (Field, 2013, p. 221).

4.2.2 Formant Frequency Analysis (F1 and F2)

Acoustic measurements were conducted using Praat software to determine vowel quality differences (Boersma & Weenink, 2023).

/ɪ/ vs. /iː/ Contrast Native speakers demonstrated clear separation in F1 and F2 values. However, Iraqi learners showed overlapping formant ranges, indicating vowel merging.

Group

F1 Mean (Hz) F2 Mean (Hz) Native /ɪ/

390 ,1990 ,Iraqi /ɪ/, 350, 2100, Native /iː/

300 ,2200 ,Iraqi /iː/, 320, 2150

The acoustic proximity between Iraqi learners' /ɪ/ and /iː/ suggests incomplete phonemic differentiation.

4.2.3 Central Vowels (/ʌ/, /ɜː/, /ə/)

Central vowels demonstrated the highest deviation from native norms.

/ʌ/ was frequently realized as /a/

/ɜː/ was approximated as /eː/ or /aː/

Schwa /ə/ was rarely reduced

Formant analysis confirmed that Iraqi learners' productions of /ʌ/ had significantly lower F2 values than native norms, indicating back vowel substitution (Ladefoged & Johnson, 2015, p. 98).

4.2.4 Vowel Reduction Patterns

Analysis of unstressed syllables revealed that 78% of participants failed to reduce vowels to schwa in carrier sentences.

Example:

Target: "about" /əˈbaʊt/

Produced: /aˈbaʊt/

This indicates absence of vowel reduction in learner speech.

4.3 Perception Results

4.3.1 Identification Accuracy

The perception test consisted of 40 stimuli. Mean accuracy rate was calculated.

Accuracy (%)

/ɪ/ vs. /iː/ 62%

/ʊ/ vs. /uː/ 65%

/æ/ vs. /ʌ/ 48%

/ʌ/ vs. /ɑː/ 51%

The lowest accuracy was observed for /æ/ vs. /ʌ/, suggesting difficulty in discriminating front-low vs. central vowels.

4.3.2 Correlation Between Perception and Production

Pearson correlation analysis showed a moderate positive correlation ($r = .61$, $p < .01$) between perception accuracy and production accuracy. Participants who scored higher in perception tasks also demonstrated more accurate vowel production.

4.4 Error Frequency Analysis

Error categorization revealed the following patterns:

Error Type

Frequency (%) .Vowel merging 32%

Length neutralization, 27%

Central vowel substitution ,24%

Lack of reduction, 17%

The most frequent error involved merging tense and lax vowels.

4.5 Comparison Across Proficiency Levels

Participants were divided into:

Advanced learners demonstrated higher perception accuracy (74%) compared to intermediate learners (56%).However, even advanced learners showed persistent difficulty with central vowels.

Chapter Five

5.1 Discussion

This chapter interprets the findings presented in Chapter Four in light of theoretical frameworks and previous research on cross-linguistic influence in second language phonology. The discussion focuses on explaining why Iraqi learners demonstrated systematic vowel merging, duration neutralization, and central vowel substitution. The findings are examined in relation to the Contrastive Analysis Hypothesis, Interlanguage theory, the Speech Learning Model (SLM), and the Perceptual Assimilation Model (PAM). Implications for phonological theory and pronunciation pedagogy are also discussed.

5.2 Cross-Linguistic Influence and Vowel Inventory Differences

The results confirmed that Iraqi learners experienced the greatest difficulty with English vowels absent in the Iraqi Arabic vowel system, particularly central vowels such as /ʌ/ and /ɜː/. This finding aligns with predictions of the Contrastive Analysis Hypothesis, which argues that structural differences between L1 and L2 create learning difficulties. However, the results also revealed that not all structurally different vowels were equally problematic. For example, although English includes multiple front vowel contrasts absent in Arabic, learners performed relatively better on /ɪ/ vs. /iː/ compared to /æ/ vs. /ʌ/. This partially challenges the strong version of CAH, supporting later critiques that structural difference alone does not fully predict learning difficulty (Wardhaugh, 1970, p. 125).

Therefore, while contrastive analysis provides a useful starting point, the results suggest that cognitive perception processes must also be considered.

5.3 Interpretation Through the Speech Learning Model (SLM)

The overlapping acoustic values for /ɪ/ and /iː/ observed in Chapter Four strongly support Flege’s Speech Learning Model. According to SLM,

learners tend to assimilate L2 sounds into existing L1 categories when they perceive them as similar . Iraqi Arabic includes /i/ and /iː/, but does not distinguish between tense and lax vowels in the same phonetic manner as English. Consequently, Iraqi learners likely perceive English /ɪ/ and /iː/ as variants of a single familiar category. This phenomenon, known as "equivalence classification," prevents the formation of a new phonetic category . The moderate correlation found between perception and production accuracy (r = .61) further supports SLM's claim that perception accuracy precedes and predicts production accuracy (Major, 2001, p. 74).

5.4 Perceptual Assimilation and Central Vowel Difficulty

The extremely low perception accuracy for /æ/ vs. /ʌ/ (48%) can be interpreted through Best's Perceptual Assimilation Model. PAM predicts that when two L2 sounds are assimilated into one L1 category (single-category assimilation), discrimination becomes highly difficult . In Iraqi Arabic, there is no central vowel equivalent to /ʌ/. Learners appear to assimilate both /æ/ and /ʌ/ into the Arabic /a/ category. This explains both the perceptual confusion and production overlap observed in Chapter Four. These findings align with previous research on Arabic-speaking learners, which identified central vowels as particularly problematic (Wahba, 1998, p. 58).

5.5 Vowel Duration Neutralization

The significant shortening of tense vowels by Iraqi learners reflects cross-linguistic influence related to vowel timing systems. Although Arabic distinguishes between short and long vowels, the phonetic realization of duration does not correspond exactly to English tense-lax distinctions. Arabic vowel length is phonemic and contrastive, while English vowel duration is partially conditioned by phonetic context (Roach, 2009, p. 75).

The results suggest that Iraqi learners transfer Arabic timing patterns into English production. This confirms previous findings that L1 temporal patterns influence L2 phonetic realization (Al-Ani, 2008, p. 112).

5.6 Lack of Vowel Reduction and Rhythm Differences

One of the most striking findings was the high rate (78%) of failure to reduce unstressed vowels to schwa. This pattern reflects fundamental rhythmic differences between Arabic and English. English is a stress-timed language characterized by vowel reduction in unstressed syllables, whereas Arabic exhibits more syllable-timed characteristics and does not rely heavily on vowel centralization .This difference explains why Iraqi learners maintain full vowel quality in unstressed syllables. The result is unnatural rhythm and reduced native-like fluency (Kharma & Hajjaj, 1989, p. 91).

5.7 Proficiency Effects

Although advanced learners performed better overall, persistent difficulty with central vowels remained. This suggests that certain phonetic contrasts may fossilize even at higher proficiency levels, supporting interlanguage fossilization theory. The persistence of these errors indicates that exposure alone is insufficient for complete phonological restructuring. Explicit phonetic training may be necessary (Celce-Murcia et al., 2010, p. 305).

5.8 Comparison with Previous Studies

The findings are consistent with:

Al-Tamimi & Khattab (2015), who reported tense-lax merging among Arabic learners . Major (2001), who observed similarity-based transfer in vowel acquisition (p. 83). Best (1995), who emphasized perceptual assimilation patterns (p. 173). However, the present study contributes

specifically by focusing on Iraqi Arabic dialect, which has been underrepresented in phonological research.

5.9 Theoretical Implications

The results reinforce the idea that cross-linguistic influence operates at both perceptual and production levels. Structural differences alone do not determine difficulty; perceived similarity plays a crucial role.

The findings provide empirical support for:

The Speech Learning Model

The Perceptual Assimilation Model

Interlanguage theory

They also demonstrate that cross-linguistic influence is systematic rather than random.

Conclusion

This study set out to investigate cross-linguistic influence in the acquisition of English vowels by Iraqi learners, focusing on both perceptual and production dimensions. The findings provide clear empirical evidence that Iraqi Arabic phonological structure plays a decisive role in shaping learners' English vowel system. The results demonstrated systematic vowel merging, particularly in tense-lax contrasts such as /ɪ/ vs. /iː/ and /ʊ/ vs. /uː/. Acoustic overlap and reduced duration contrast confirmed incomplete phonemic differentiation. These findings strongly support the Speech Learning Model, which proposes that learners assimilate L2 sounds into existing L1 categories when perceived as similar . Central vowels such as /ʌ/ and /ɜː/ emerged as the most problematic categories. Both perceptual confusion and production deviation were observed. This aligns with the

Perceptual Assimilation Model, which predicts difficulty when multiple L2 sounds are mapped onto a single L1 category .

The absence of central vowels in Iraqi Arabic significantly contributes to this challenge. Additionally, vowel reduction patterns revealed persistent transfer of Arabic rhythmic structure into English production. Learners rarely reduced unstressed vowels to schwa, reflecting fundamental differences between stress-timed English and the rhythmic structure of Arabic (Roach, 2009). This finding highlights that cross-linguistic influence extends beyond segmental features to suprasegmental characteristics. The moderate correlation between perception and production further confirms that accurate perception is foundational to accurate articulation. Learners who demonstrated higher perceptual discrimination also produced more native-like vowel contrasts. This reinforces the theoretical position that phonological acquisition is cognitively mediated and perceptually grounded (Major, 2001).

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