

English Phonological Interference in Arabic Language Learning: A Systematic Literature Review

Muhammad Fariq Heemal Attruk¹, Dika Ayu Sholihah²

¹International Islamic University Malaysia

²SMA IIBS Ar-Rohmah Putri, Malang, Indonesia.

Article history

Received: 17 April 2026

Revised: 12 May 2026

Accepted: 03 June 2029

Keywords

phonological interference

English-Arabic

systematic literature review

Language learning

Abstract

This systematic literature review investigates phonological interference from English into Arabic, an area that has received far less scholarly attention than interference in the opposite direction. The review was designed to identify the major types of phonological interference experienced by native English-speaking learners of Arabic, determine which Arabic phonological features are most affected, examine the research methodologies commonly used in previous studies, and analyze the pedagogical implications reported in the literature. Following the PRISMA 2020 guidelines, a systematic search was carried out in the Scopus database and produced 189 records. After the screening process, eight peer-reviewed journal articles and conference proceedings published between 2010 and 2026 fulfilled the inclusion criteria. Data extraction was conducted independently by two reviewers, and the risk of bias was evaluated using six methodological criteria. The findings were synthesized through narrative and thematic analysis. The review revealed that phonological interference mainly occurs in three forms: perceptual difficulties in distinguishing Arabic consonant contrasts that do not exist in English, production-related errors such as geminate hypoarticulation and covert contrast, and orthographically mediated errors associated with the deep orthography of Arabic. Among the phonological features examined, emphatic consonants, gemination, and short vowels emerged as the most vulnerable to interference. The studies reviewed primarily employed perception experiments, production experiments, corpus-based error analysis, and quasi-experimental approaches. The pedagogical implications highlighted most consistently across the studies include the importance of explicit phonological instruction, the consistent use of diacritics, the integration of acoustic tools such as PRAAT, and the development of learning environments that provide rich authentic input. Overall, these findings offer a comprehensive synthesis of current research on English-to-Arabic phonological interference and provide an empirical basis for developing Arabic language teaching materials and curricula that are more responsive to the needs of native English-speaking learners.

1. Introduction

Arabic is widely recognized as one of the languages that has a highly complex and distinctive phonological system. The language contains 29 consonants, including emphatic (pharyngealized), pharyngeal, and uvular consonants, along with a vowel system consisting of only six phonemes that also contrast in vowel length. These characteristics often create major difficulties for native English speakers who learn Arabic as a second language (L2) (Addow et al., 2025). Previous contrastive studies have shown that the sound systems of Arabic and English differ substantially. English does not contain emphatic, pharyngeal, uvular, or phonemic geminate consonants, whereas Arabic lacks sounds such as /p/, /v/, /g/, /ŋ/, /tʃ/, and /dʒ/ (Alkhateeb, 2016; Sabbah, 2015). Because of these differences, learners are highly susceptible to phonological interference, which refers to the negative transfer of the first language (L1) sound system into the target language (L2) (Sabbah, 2015).

Research on phonological interference between Arabic and English has been conducted for many years. However, most previous studies have concentrated on interference from Arabic into English rather than the opposite direction. One of the earlier studies by Flege and Port (1981) demonstrated that Arabic speakers tend to transfer Voice Onset Time (VOT) patterns and glottal control when producing English stop consonants. Later studies reported similar findings, showing that Arabic speakers often struggle to pronounce /p/ and /v/, insert epenthetic vowels to separate consonant clusters, and apply Arabic stress patterns based on syllable weight when speaking English (Abu-Guba & Abu Qub'a, 2026; Alkhateeb, 2016;

*Corresponding author, email: fariqhemal@gmail.com

doi: <https://doi.org/10.71131/7tpfb963>

© 2026 The Authors

This work is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](#)

Altakhaineh et al., 2024; Zoghbor, 2018). In a literature survey, Sabbah (2015) also emphasized that studies examining Arabic→English interference are far more numerous than those focusing on English→Arabic interference.

In contrast, research discussing phonological interference from English into Arabic is still limited and has not yet been systematically synthesized. Several individual studies have nevertheless contributed important findings. Hayes-Harb and Durham (2016) reported that native English-speaking learners rely heavily on the vowel following the consonant when distinguishing Arabic emphatic consonants. Mathieu (2015) found that the use of foreign scripts may interfere with learners' acquisition of the /h/-/χ/ contrast. Al Midhwah and Alhawary (2020) showed that the consistent use of diacritics can improve the accuracy of short vowel pronunciation. Meanwhile, Aldossari et al. (2024) identified cases of geminate hypoarticulation among advanced English-speaking learners of Arabic, and Aljutaily and Almutairi (2026) introduced the idea of covert contrast as a hidden stage in phonological development. Although these studies provide valuable insights, the findings remain fragmented because no comprehensive synthesis has yet been conducted. As a result, it is still difficult to obtain a clear and unified understanding of English interference in Arabic phonology.

The absence of a systematic synthesis highlights an important research gap. A comprehensive understanding of phonological interference from English into Arabic is necessary not only for the development of second language phonology theories, but also for designing more effective teaching materials and pedagogical strategies. The Speech Learning Model (SLM-r), examined by Al-Kinany et al. (2022) in the context of Arabic-English phoneme perception, and the Perceptual Assimilation Model (PAM), which underpins Polka's (1991) work on non-native contrast difficulty, both suggest that L2 sounds without direct equivalents in the learners' L1 are especially difficult to acquire because learners tend to assimilate unfamiliar sounds into the closest categories available in their native language. In addition, the Contrastive Hierarchy framework discussed by Archibald (2022) explains that phonological features that cannot be processed through the L1 contrastive hierarchy are likely to become persistent sources of interference.

The issue of interference becomes even more complex when orthographic factors are involved. Hayes-Harb and Barrios (2021), through an extensive review, identified four variables that influence the effect of orthography on L2 phonological acquisition: systematicity, familiarity, congruence, and perceptibility. In Arabic language learning, the deep orthography of Arabic and the use of diacritics create a unique learning situation. On the one hand, diacritics may help learners recognize short vowels and gemination more accurately (Al Midhwah & Alhawary, 2020; Aldossari et al., 2024). On the other hand, introducing Arabic script too early or relying on inappropriate transliteration systems may hinder the development of accurate phonological representations (Mathieu, 2015; Shepperd et al., 2025).

Considering the complexity and diversity of previous findings, a Systematic Literature Review (SLR) that rigorously examines studies on phonological interference from English into Arabic is strongly needed. This SLR is intended to become the first review that specifically focuses on this direction of interference while covering both perception and production aspects, as well as moderating variables such as vowel context, orthography, and proficiency level. To maintain a clear scope, the review is guided by four research questions (RQs): (1) What types of phonological interference are commonly experienced by native English-speaking learners of Arabic?; (2) Which Arabic phonological features are most affected by English interference?; (3) What research methodologies are commonly applied in studies of phonological interference in Arabic language learning?; and (4) What pedagogical implications have been reported in relation to phonological interference in Arabic language learning? These questions aim to examine the forms of interference, the phonological features involved, the dominant research approaches, and the pedagogical implications for Arabic teaching. By systematically addressing these four RQs, this SLR is expected to provide a comprehensive overview of current research on English→Arabic phonological interference, identify existing research gaps, and contribute an empirical foundation for developing Arabic teaching materials and curricula that better address the needs of native English-speaking learners.

2. Method

2.1. Study Design

This study adopted a Systematic Literature Review (SLR) approach, which is understood as a systematic, transparent, and replicable method for identifying, evaluating, and synthesizing studies relevant to a particular research topic (Xiao & Watson, 2017). The review process followed the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure

transparency and completeness in reporting (Page et al., 2021). This approach was selected because it can minimize bias and improve the accountability of each stage of the review process (Booth et al., 2016).

2.2. Research Questions

Based on the framework proposed by Xiao and Watson (2017), this review was guided by four research questions (RQs): (1) What types of phonological interference are commonly experienced by native English-speaking learners of Arabic?; (2) Which Arabic phonological features are most affected by English interference?; (3) What research methodologies are commonly used in studies on phonological interference in Arabic language learning?; and (4) What pedagogical implications have been reported regarding phonological interference in Arabic language learning?

2.3. Inclusion and Exclusion Criteria

Clear inclusion and exclusion criteria were established to ensure that only relevant and high-quality studies were included in the review (Xiao & Watson, 2017). Studies were included if they discussed phonological interference, either in perception and/or production, within Arabic language learning or cross-linguistic influence from English into Arabic; involved native English speakers as Arabic L2 learners or naive listeners; were published between 2010 and 2026; were peer-reviewed journal articles or conference proceedings; had accessible full texts; and were written in English or Arabic. In contrast, studies were excluded if they were unrelated to phonological interference, did not focus on Arabic language learning, examined languages other than Arabic and English, consisted of theses, dissertations, books, book chapters, or unpublished manuscripts, were duplicate publications, or did not provide accessible full texts. The criteria are summarized in Table 1.

Table 1. Inclusion and Exclusion Criteria

No.	Inclusion Criteria	Exclusion Criteria
1	Studies addressing phonological interference (perception and/or production) in Arabic language learning or cross-linguistic influence from English to Arabic	Studies not related to phonological interference
2	Participants are native English speakers (Arabic L2 learners or naive listeners)	Studies not related to Arabic language learning
3	Published between 2010 and 2026 (inclusive)	Studies focusing only on languages other than Arabic and English
4	Peer-reviewed journal articles or conference proceedings	Theses, dissertations, books, book chapters, unpublished manuscripts
5	Full text available and accessible	Duplicate articles
6	Written in English or Arabic	Full text not available or inaccessible

2.4. Search Strategy

The literature search was systematically conducted in the Scopus database in April 2026 because Scopus offers broad multidisciplinary coverage. Following recommended SLR procedures, an initial scoping search was first carried out to identify the characteristics and scope of the available literature before the main search was performed (Booth et al., 2016). The primary search string applied to titles, abstracts, and keywords was ("Arabic" AND "English") AND ("pronunciation" OR "phonology"). Several filters were then applied, including publication year (2010–2026), document type (Article and Conference Paper), and language (English and Arabic). The search produced 189 documents, and all metadata were exported in CSV format. In addition, Google Scholar was used only to retrieve full texts that were not directly accessible through Scopus. Backward and forward citation tracking were also conducted to complement the literature collection process (Xiao & Watson, 2017).

2.5. Selection Process

The article selection process followed the three-stage procedure proposed by Xiao and Watson (2017), namely title screening, abstract screening, and full-text screening. The entire process was documented using the PRISMA 2020 flow diagram (Page et al., 2021). Two authors independently conducted each stage, and any disagreements were resolved through discussion. During the first stage (title

screening), all 189 titles were examined. Articles that were clearly irrelevant, such as studies focusing on the reverse interference direction, topics outside phonology, or languages other than Arabic and English, were excluded, while ambiguous titles were retained for the next stage. In the second stage (abstract screening), the remaining abstracts were evaluated based on the inclusion criteria, especially participant background, focus on phonological interference, and publication period (2010–2026). After this stage, 178 articles were excluded, leaving 11 potentially relevant studies. In the final stage (full-text retrieval and screening), attempts were made to obtain the full texts through Google Scholar, ResearchGate, institutional library access, and publisher websites. Despite maximum effort, three articles could not be accessed because of paywall restrictions. The remaining eight articles were successfully retrieved and fully reviewed. All eight studies met the inclusion criteria, and no further exclusions were made. Consequently, the final corpus consisted of eight articles. The entire process was carefully documented to ensure transparency and replicability (Booth et al., 2016).

2.6. Data Extraction

Data from the eight selected studies were extracted using a structured table developed to address the four research questions. The extracted information included bibliographic details (authors, year, and source), research objectives, participant characteristics (type, number, and linguistic background), research design and methodology, investigated phonological features, major findings related to interference, and pedagogical implications. To increase transparency and minimize bias, the extraction process was conducted independently by two authors and later cross-checked (Xiao & Watson, 2017). Any disagreements were resolved through discussion and re-examination of the original studies.

2.7. Risk of Bias Assessment

The risk of bias in each included study was evaluated using six criteria adapted from methodological guidelines for systematic reviews (Booth et al., 2016) and reported according to PRISMA 2020 recommendations (Page et al., 2021). The six criteria included the clarity of the research question, the appropriateness of the study design, the representativeness of the sample, the validity and reliability of the instruments, the appropriateness of the analysis methods, and the extent to which the study minimized selection bias. The detailed criteria are presented in Table 2.

Table 2. Risk of Bias Assessment Criteria

Code	Criterion	Assessment Question
RQ	Clear research question	Is the research question explicitly and clearly formulated?
DS	Appropriate study design	Is the study design suitable for answering the research question?
RS	Representative sample	Is the sampling procedure adequately described and representative of the target population?
IV	Valid & reliable instrument	Are the instruments (e.g., perception tasks, acoustic analysis) valid, reliable, and consistently applied?
AN	Appropriate analysis	Are the statistical or qualitative analysis methods appropriate for the design and research question?
SB	Low risk of selection bias	Did the study use random assignment or an adequate mechanism to avoid selection bias (e.g., randomization, matching, or strong statistical control)?

Two authors independently assessed each study using these six criteria. Each criterion was categorized as “Yes” (low risk of bias), “No” (high risk of bias), or “Unclear” (insufficient information). Any disagreements were resolved through discussion, and no automation tools were used during the assessment process. The overall risk of bias was classified into three categories: Low (all criteria fulfilled), Moderate (one or more criteria not fully met but without critical weaknesses), and High (serious methodological limitations). The results are presented in Table 2 in the Results section. Importantly, no studies were excluded based on quality assessment; instead, the bias assessment was used to support the interpretation of findings.

2.8. Certainty Assessment

This review did not conduct a formal certainty or confidence assessment of the body of evidence. The decision was made because the review aimed to provide a narrative thematic synthesis of studies on phonological interference rather than produce GRADE-style recommendations for policy or practice. The

review focused on identifying, describing, and synthesizing recurring patterns across studies instead of measuring the strength of evidence for specific effect sizes. Therefore, formal certainty assessment tools such as GRADE-CERQual were not applied.

2.9. Data Synthesis

Since the included studies employed diverse methodologies, the data were synthesized narratively and thematically (Booth et al., 2016). Xiao and Watson (2017) explain that narrative thematic synthesis is appropriate when studies cannot be statistically combined, as in a meta-analysis. Therefore, findings from each study were grouped according to themes aligned with the research questions, namely types of phonological interference, affected phonological features, research methodologies, and pedagogical implications. The patterns emerging across studies were then compared and summarized qualitatively to answer each research question. The synthesis results are presented in the form of structured narratives supported by tables and a PRISMA flow diagram (Page et al., 2021).

3. Result

The study selection process is presented in the PRISMA 2020 flow diagram in Figure 1. A total of eight studies met the inclusion criteria and were included in the final synthesis. The characteristics of these studies are summarized in Table 3, while the results of the risk of bias assessment are presented in Table 4. Overall, most studies demonstrated a low risk of bias, although several studies were categorized as having a moderate risk, mainly because of limitations related to participant selection procedures.

Figure 1. PRISMA 2020 flow diagram of study selection.

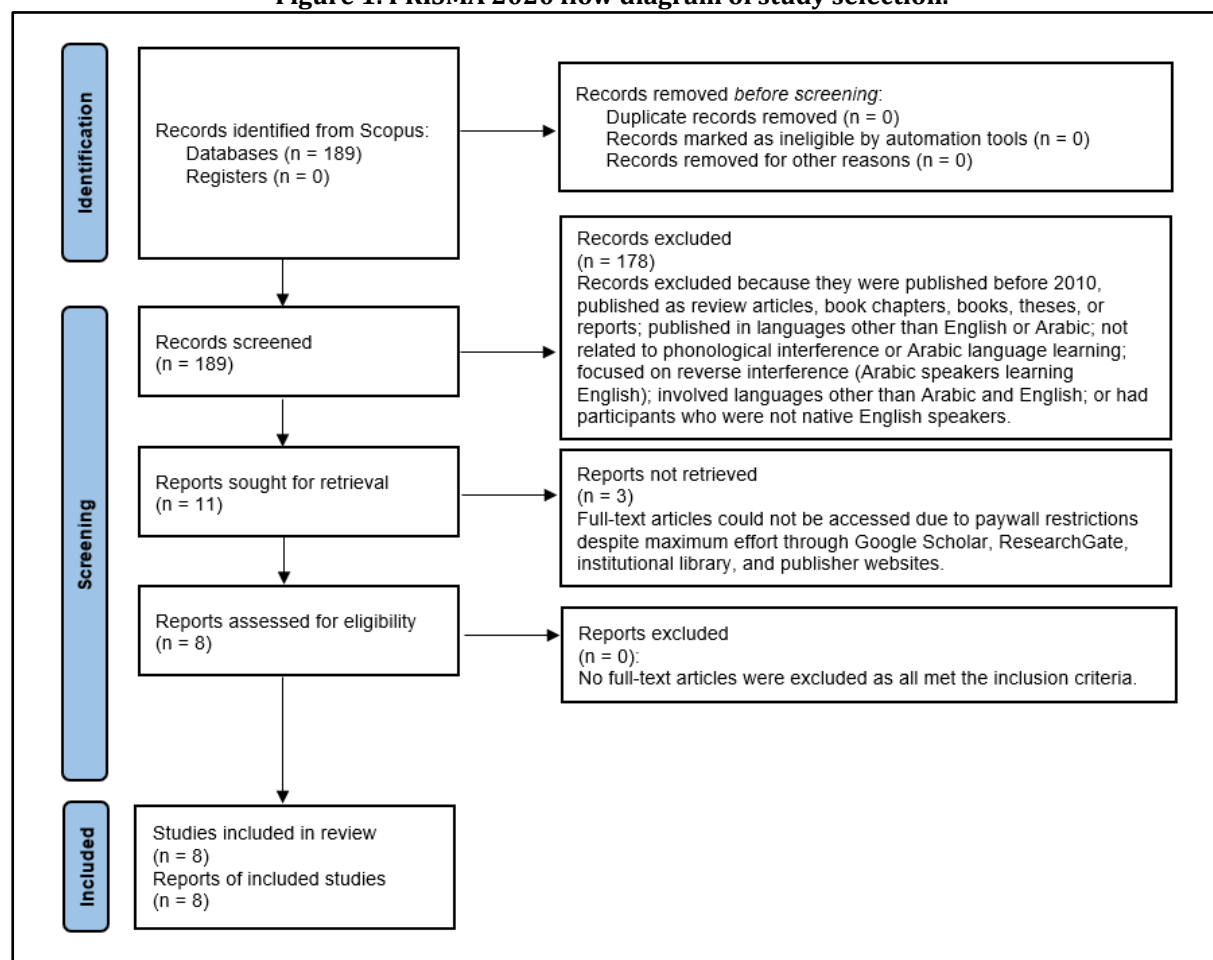


Table 3. Characteristics of Included Studies (n = 8)

No.	Author(s) (Year)	Study Design	Participants	Phonological Feature(s)	Key Finding (Interference)
-----	---------------------	--------------	--------------	----------------------------	-------------------------------

1	Hayes-Harb & Durham (2016)	Quantitative experimental	40 naive English listeners	/d-d ^ɕ / in /a, i, u/ contexts	Accuracy was lowest when followed by /i/ or /u/
2	Aldossari et al. (2024)	Quantitative experimental	15 advanced English learners	Gemination	Shorter duration (0.03–0.04s) compared to native speakers (0.09–0.10s)
3	Aljutaily & Almutairi (2026)	Mixed-methods	40 English learners (AFL + ASL)	/t ^ɕ -t/, /s ^ɕ -s/	47.5% showed covert contrast; /s ^ɕ / was more difficult
4	Shehata (2024)	Quantitative experimental	60 intermediate learners	/d-d ^ɕ /, /h-h̃/, /s-s ^ɕ /, /t-t ^ɕ /	/d-d ^ɕ / and /h-h̃/ were the most difficult contrasts
5	Mathieu (2015)	Quantitative experimental	84 naive English listeners	/h/ vs /χ/	44% accuracy on mismatch pairs
6	Al Midhwah & Alhawary (2020)	Quasi-experimental	54 learners (beginner-advanced)	Short vowels (/a, i, u/)	Without consistent diacritics: slower reading and lower accuracy
7	Brosh (2015)	Mixed-methods	63 English learners (2nd–3rd year)	Emphatics, pharyngeals, uvulars, vowel length	32% wrong letter choice; 24% omission of long vowels
8	Rytting et al. (2014)	Corpus-based	62 English learners (≥2 semesters)	All non-glide consonants and gemination	27.9% error rate on 41,121 target consonants

Table 4. Risk of Bias Assessment (Yes/No)

No.	Author(s) (Year)	RQ	DS	RS	IV	AN	SB	Overall Risk
1	Hayes-Harb & Durham (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Low
2	Aldossari et al. (2024)	Yes	Yes	Yes	Yes	Yes	Yes	Low
3	Aljutaily & Almutairi (2026)	Yes	Yes	Yes	Yes	Yes	Yes	Low
4	Shehata (2024)	Yes	Yes	Yes	Yes	Yes	Yes	Low
5	Mathieu (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Low
6	Al Midhwah & Alhawary (2020)	Yes	Yes	Yes	Yes	Yes	No	Moderate
7	Brosh (2015)	Yes	Yes	Yes	Yes	Yes	No	Moderate
8	Rytting et al. (2014)	Yes	Yes	Yes	Yes	Yes	No	Moderate

Note: RQ = Clear research question; DS = Appropriate study design; RS = Representative sample; IV = Valid and reliable instrument; AN = Appropriate analysis; SB = Low risk of selection bias (e.g., random assignment).

3.1. Types of Phonological Interference (RQ1)

The synthesis of the eight selected studies showed that phonological interference experienced by native English-speaking learners of Arabic generally appears in three major forms: perceptual interference, production interference, and orthographically mediated interference affecting pronunciation.

At the perceptual level, the most common form of interference involves difficulties distinguishing Arabic consonant contrasts that do not exist in the English phonological system. Hayes-Harb and Durham (2016) found that English-speaking learners rely heavily on the vowel following a consonant, rather than the consonant itself, when distinguishing the emphatic contrast /d-/d^ɕ/. Their findings showed that perception accuracy dropped considerably when the following vowel was /i/ or /u/, since English does not

phonemically differentiate emphatic and non-emphatic vowel allophones in these contexts. Similar findings were reported by Shehata (2024), who demonstrated that English learners consistently struggled with several Arabic consonant contrasts, namely /d-d^ʕ/, /h-h/ , /s-s^ʕ/, and /t-t^ʕ/ . Among these contrasts, /d-d^ʕ/ and /h-h/ were identified as the most difficult. Mathieu (2015) further supported these findings by showing that learners also experienced major difficulty perceiving the /h-/χ/ contrast. Without orthographic support, participants achieved only around 44% accuracy in distinguishing minimal pairs differing solely in these two consonants, indicating a tendency toward contrast neutralization.

At the production level, phonological interference mainly appears in learners' difficulty producing Arabic phonological features that are absent in English. Aldossari et al. (2024) reported that advanced English-speaking learners tended to produce Arabic geminates with significantly shorter durations (approximately 0.03–0.04 seconds) compared to native Arabic speakers (around 0.09–0.10 seconds). This phenomenon, referred to as geminate hypoarticulation, suggests that learners transfer the absence of consonant length contrast from their first language into Arabic. In addition, Aljutaily and Almutairi (2026) introduced the concept of covert contrast, which refers to subtle acoustic differences that can be measured instrumentally but are not strong enough to be recognized by native Arabic listeners. Their study revealed that nearly half of the participants (47.5%) demonstrated covert contrast in at least one phonemic pair, indicating that interference does not always result in complete pronunciation failure but may instead reflect partial or developing phonological mastery.

Phonological interference was also found to occur through orthographic mediation. Al Midhwah and Alhawary (2020) explained that learners who are unfamiliar with Arabic diacritics often struggle to pronounce Arabic words accurately because Arabic orthography does not consistently represent short vowels. Brosh (2015) reinforced this finding by showing that 32% of spelling errors resulted from incorrect letter selection caused by difficulties distinguishing sounds such as /h/ versus /h/ and /s^ʕ/ versus /s/. Likewise, Rytting et al. (2014), through analysis of the ArCADE corpus, demonstrated that 27.9% of 41,121 target consonant responses in auditory dictation tasks contained perception-related errors, including consonant substitution, deletion, and gemination errors.

3.2. Arabic Phonological Features Most Affected (RQ2)

The synthesis identified three major categories of Arabic phonological features that are especially vulnerable to English interference: emphatic and post-velar consonants, gemination, and short vowels.

Among these features, emphatic consonants—particularly the contrasts /d-d^ʕ/, /s-s^ʕ/, and /t-t^ʕ/—were consistently reported as the most problematic. Hayes-Harb and Durham (2016) confirmed that learners' perception of the /d-d^ʕ/ contrast is strongly influenced by the following vowel context. Similarly, Aljutaily and Almutairi (2026) found that the emphatic fricative /s^ʕ/ was more difficult to acquire than the emphatic stop /t^ʕ/ . Only 65% of learners demonstrated overt contrast for /s^ʕ/-/s/, whereas 77.5% successfully distinguished /t^ʕ/-/t/. Shehata (2024) further reported that the /d-d^ʕ/ contrast remained significantly more difficult to perceive than /s-s^ʕ/ and /t-t^ʕ/, even after one semester of instruction. In addition to emphatic consonants, the pharyngeal consonant /h/ and the uvular consonant /χ/ were also identified as highly vulnerable to interference. Mathieu (2015) demonstrated that English-speaking learners tend to assimilate these two sounds into a single perceptual category. Brosh (2015) supported this conclusion through spelling analysis, which revealed frequent substitution errors involving emphatic, pharyngeal, and uvular consonants.

Gemination, or consonant length contrast, emerged as the second most affected feature. Aldossari et al. (2024) showed that English-speaking learners consistently produced geminate consonants with shorter durations than native speakers. At the perceptual level, Rytting et al. (2014) also highlighted the vulnerability of gemination by identifying frequent gemination and degeneration errors in the ArCADE corpus.

The third feature strongly affected by interference was the Arabic short vowel system (/a/, /i/, /u/). Al Midhwah and Alhawary (2020) found that learners who read texts without diacritics often failed to determine the correct short vowels consistently, leading to pronunciation errors that altered word meanings. Brosh (2015) further demonstrated that omission of long vowels such as alif, waw, and yaa accounted for 24% of the total spelling errors, indicating that vowel quantity remains a persistent source of difficulty for English-speaking learners of Arabic.

3.3. Research Methodologies Used (RQ3)

The methodologies employed in the eight reviewed studies were diverse, although they could generally be grouped into four dominant approaches: perception experiments, production experiments, corpus or writing-based error analysis, and quasi-experimental studies.

Perception experiments were the most commonly used methodology. Hayes-Harb and Durham (2016) applied cross-language vowel identification and AXB discrimination tasks using acoustically manipulated nonword stimuli with 40 naive listeners. Shehata (2024) employed a forced-choice word identification task with a pre-test and post-test design involving 60 learners from both at-home and study-abroad contexts. Mathieu (2015), meanwhile, designed a three-phase word-learning experiment specifically to isolate the effect of orthography on learners' acquisition of the /h/-/χ/ contrast.

Production-based experimental studies combined pronunciation tasks with instrumental acoustic analysis. Aldossari et al. (2024) used delayed imitation tasks, reading tasks with and without diacritics, and consonant duration measurements analyzed through PRAAT software. Aljutaily and Almutairi (2026) adopted a mixed-methods design integrating acoustic measurements such as Voice Onset Time (VOT), fricative duration, and vowel formants (F1 and F2), together with perception tasks and individual-level statistical analysis using PERMANOVA.

Corpus-based and writing-error analyses were employed by Rytting et al. (2014) and Brosh (2015). Rytting et al. (2014) constructed the ArCADE corpus using auditory dictation tasks completed by 62 participants, generating 41,121 target consonant responses that were analyzed phonemically using a weighted Levenshtein edit distance algorithm. Brosh (2015) analyzed 457 spelling errors from writing tasks completed by 63 participants and supplemented the analysis with questionnaires and semi-structured interviews.

A quasi-experimental design was used by Al Midhwah and Alhawary (2020), who compared two learner groups using textbooks with and without consistent diacritics. Reading speed and pronunciation accuracy were measured using PRAAT and ELAN software, while the statistical analysis employed two-way repeated-measures ANOVA and linear mixed models.

3.4. Pedagogical Implications Reported (RQ4)

All reviewed studies discussed pedagogical implications, with most emphasizing the importance of explicit instruction, visual and orthographic support, and the integration of technology to address phonological interference in Arabic language learning.

The most frequently emphasized implication was the importance of explicit phonological instruction. Aljutaily and Almutairi (2026) found that the amount of formal instruction, measured through credit hours, had a greater impact on phonological development than the length of residence in an Arab country. Learners with more than 120 credit hours were more likely to demonstrate overt contrast, while those with fewer than 75 hours generally remained at the covert contrast stage. Hayes-Harb and Durham (2016) recommended that teachers explicitly direct learners' attention to the role of following vowels as cues for distinguishing emphatic consonants. Likewise, Aldossari et al. (2024) highlighted the need for explicit training focused on consonant duration to reduce geminate hypoarticulation.

Another major implication concerned the use of diacritics and visual support. Al Midhwah and Alhawary (2020) demonstrated that consistent use of diacritics in teaching materials improved reading speed, pronunciation accuracy, and word comprehension across all proficiency levels. Importantly, they also found that exposure to diacritics did not negatively affect learners' later ability to read unvowelized texts. Aldossari et al. (2024) similarly reported that the shadda diacritic helped learners produce geminate consonants more accurately by visually emphasizing consonant length. However, Brosh (2015) and Mathieu (2015) added an important caution. Mathieu (2015) argued that introducing Arabic script too early, before learners develop sufficient phonological understanding, may actually hinder the formation of accurate phonological representations, especially for visually similar contrasts such as /h/ and /χ/.

Several studies also highlighted the value of technology and acoustic tools in pronunciation instruction. Aljutaily and Almutairi (2026) recommended using software such as PRAAT to provide objective pronunciation feedback, particularly because covert contrasts are often undetectable through ordinary listening alone. Similarly, Rytting et al. (2014) emphasized the potential of the ArCADE corpus for developing learner-adapted spelling correction systems and computer-based phonemic discrimination training.

Learning environment and instructional context were also found to influence phonological development. Shehata (2024) reported that learners participating in study-abroad programs performed better than at-home learners in perceiving the /h-h/ and /d-d⁵/ contrasts. This finding suggests the importance of promoting structured study-abroad opportunities in Arab countries, accompanied by post-return support programs. The study additionally found that gender did not significantly affect phonological acquisition, indicating that instructional approaches should focus on learners' individual needs rather than gender-based assumptions.

Finally, Brosh (2015) emphasized the importance of integrating language skills and strengthening learners' morphological awareness. The study recommended combining reading and writing instruction

while also developing learners' understanding of Arabic root-and-pattern (wazan) structures in order to reduce spelling errors caused by phonological interference.

4. Discussion

4.1. Types of Phonological Interference (RQ1)

The findings of this synthesis indicate that phonological interference experienced by native English-speaking learners of Arabic generally appears in three major forms: perceptual errors, production errors, and orthographically mediated errors. These findings are consistent with the framework proposed by Sabbah (2015), who differentiated between interlingual errors caused by first language transfer and intralingual errors resulting from overgeneralization within the target language itself. In the context of this SLR, most of the identified difficulties can be categorized as interlingual because the problematic Arabic features—such as emphatic consonants, gemination, and short vowels—do not exist in the English phonological system.

At the perceptual level, the tendency of English-speaking learners to rely on the quality of following vowels when distinguishing emphatic consonants (Hayes-Harb & Durham, 2016), as well as the neutralization of the /h/-/χ/ contrast (Mathieu, 2015), can be understood through the framework developed by Werker and Tees (1984). Their influential study demonstrated that adults do not completely lose the ability to perceive non-native phonological contrasts. Instead, they reorganize their perceptual strategies so that unfamiliar sounds are processed through the filter of their first language phonemic system. As a result, sound differences that are not meaningful in English tend to be ignored. This framework helps explain why the participants in the studies by Hayes-Harb and Durham (2016) and Mathieu (2015) showed difficulty distinguishing Arabic contrasts, since they automatically assimilated Arabic sounds into the closest English phonemic categories.

Polka (1991) further argued that contrasts assimilated into two separate L1 categories are generally easier to distinguish than contrasts mapped onto a single category. In the context of this review, Arabic emphatic consonants such as /s^ʕ/ and /s/ are likely perceived by English-speaking learners as belonging to the same /s/ category, which leads to persistent perceptual confusion. By contrast, long and short vowels may be relatively easier to distinguish because English speakers already have some phonetic experience with vowel duration differences in their native language, even though vowel length itself is not phonemic in English (Al-Kinany et al., 2022).

At the production level, the findings on geminate hypoarticulation (Aldossari et al., 2024) and covert contrast in emphatic consonants (Aljutaily & Almutairi, 2026) reflect what Flege and Port (1981) described as interference in phonetic implementation. Their classic study showed that Arabic speakers transferred temporal patterns from Arabic into English stop production. Similarly, the studies reviewed in this SLR suggest that English-speaking learners transfer the absence of consonant length contrast from English into Arabic geminate production. Schwartz (2020) further strengthened this argument by showing that cross-linguistic interference may remain asymmetrical and persistent even among advanced learners. The finding by Aljutaily and Almutairi (2026) that 47.5% of learners still demonstrated covert contrast indicates that production interference should not always be interpreted as complete failure, but rather as evidence of an ongoing developmental stage in phonological acquisition.

At the orthographic level, the findings reported by Al Midhwah and Alhawary (2020) and Brosh (2015) regarding the role of diacritics and spelling errors can be interpreted using the framework proposed by Hayes-Harb and Barrios (2021). Their review identified four important variables affecting orthographic influence in second language phonology acquisition: systematicity, familiarity, congruence, and perceptibility. These variables explain why Arabic diacritics can support learners by consistently representing vowel information, while the Arabic script itself may sometimes hinder learning because visually similar letters representing contrasts such as /h/ and /χ/ are difficult for learners to differentiate (Mathieu, 2015). Recent findings by Shepperd et al. (2025) further confirmed that written input may interfere with the encoding of difficult auditory contrasts even when orthography systematically represents those differences. This evidence strongly supports the argument that Arabic script should be introduced carefully and only after learners have developed sufficient phonological awareness.

4.2. Arabic Phonological Features Most Affected (RQ2)

The three categories of Arabic phonological features identified as most vulnerable to interference—emphatic and post-velar consonants, gemination, and short vowels—reflect the strongest structural differences between Arabic and English phonology. Addow et al. (2025), in their contrastive analysis, explained that Arabic contains 29 consonants, including pharyngeal, uvular, and emphatic sounds, none of

which are found in the English consonant inventory. Because English speakers do not possess ready-made phonological categories for these sounds, they encounter substantial difficulty acquiring them, as predicted by the Speech Learning Model (SLM-r) examined by Al-Kinany et al. (2022).

The finding that the emphatic fricative /s^ʕ/ is more difficult than the emphatic stop /t^ʕ/ (Aljutaily & Almutairi, 2026) can be explained from both acoustic and perceptual perspectives. Polka (1991) argued that phonological contrasts with clearer acoustic cues and less variability are easier to perceive accurately. Emphatic fricatives in Arabic involve complex acoustic properties, including F2 lowering, Voice Onset Time variation, and inter-speaker variability, all of which increase perceptual difficulty for English-speaking learners. Archibald (2022), through the Contrastive Hierarchy framework, also explained that phonological features lacking equivalents in the learners' L1 hierarchy are especially difficult to acquire. Since emphatic consonants rely on the [pharyngeal] feature, which does not exist in English phonology, English-speaking learners struggle to process these sounds effectively.

Gemination, identified as the second most affected feature, can also be understood through comparative evidence from earlier studies. Abu Guba (2020) showed that native Arabic speakers naturally introduce gemination when pronouncing English loanwords in order to satisfy Arabic prosodic constraints, whereas Alkhateeb (2016) found that Arabic speakers often over-articulate geminate consonants in English. Interestingly, the current SLR revealed the opposite pattern: English-speaking learners tend to reduce consonant duration when producing Arabic geminates. This asymmetry demonstrates that although phonological interference occurs in both directions, the specific form of interference depends on the structure of each learner's first language system.

Short vowels emerged as the third major area of interference, particularly because of the deep orthography of Arabic. Addow et al. (2025) explained that Arabic has only six vowel phonemes—three short and three long—while English contains a much larger vowel inventory. However, learners' difficulties do not mainly involve distinguishing vowel quality. Instead, the challenge lies in accessing vowel information because Arabic orthography often omits short vowels. Consequently, English-speaking learners, who are accustomed to a relatively more transparent orthographic system, experience significant difficulty identifying the correct vowels in Arabic words (Al Midhwah & Alhawary, 2020; Al-Hamad & Mohamed, 2020).

4.3. Research Methodologies Used (RQ3)

The range of methodologies identified in this SLR—including perception experiments, production experiments, corpus-based error analysis, and quasi-experimental designs—reflects the complexity of phonological interference as a research topic. The strong dominance of experimental quantitative methods, particularly discrimination and identification tasks, is consistent with the tradition of cross-language speech perception research established by Werker and Tees (1984) and Polka (1991). Likewise, the use of instrumental acoustic analysis through PRAAT in the studies by Aldossari et al. (2024) and Aljutaily and Almutairi (2026) follows the tradition initiated by Flege and Port (1981), who demonstrated the importance of objective acoustic measurements in identifying forms of interference that may not be perceptually obvious.

The corpus-based approach used by Rytting et al. (2014) and the spelling-error analysis conducted by Brosh (2015) contributed additional methodological perspectives. Rytting et al. (2014) focused specifically on auditory perception errors through dictation tasks involving unfamiliar words, whereas Brosh (2015) connected spelling errors to phonological interference through a combination of quantitative and qualitative data analysis. Together, these approaches demonstrate that phonological interference can affect multiple modalities, including perception, production, and written representation. Supporting this argument, Al-Hamad and Mohamed (2020) found that beginner English-speaking learners frequently substituted emphatic, pharyngeal, and uvular consonants in writing, mirroring the same difficulties observed in perception and production studies.

The quasi-experimental design applied by Al Midhwah and Alhawary (2020) represents an approach that directly evaluates the effectiveness of pedagogical interventions. Their study compared learners exposed to textbooks with and without consistent diacritics. This methodology aligns with studies by Al-Shami and Cardoso (2025), who investigated the effectiveness of Text-to-Speech (TTS) systems with different levels of variability, as well as Alshangiti et al. (2023), who examined High Variability Phonetic Training (HVPT) in children. Nevertheless, findings across these studies suggest that the effectiveness of HVPT is not universal. Alshangiti et al. (2023), for example, found that low-variability training was actually more effective for children, whereas Al-Shami and Cardoso (2025) reported no significant differences between HVPT and single-voice training for adult learners. These varying findings indicate that phonological training methods should be adapted to learners' characteristics, the specific phonological contrasts being taught, and the broader learning context.

4.4. Pedagogical Implications Reported (RQ4)

The pedagogical implications emerging from the reviewed studies consistently emphasize three major areas: explicit instruction, the use of orthographic and visual support, and the integration of technology-based perception training. The finding by Aljutaily and Almutairi (2026) that formal instructional hours have a stronger impact than residence duration in an Arab country supports the argument proposed by Abu-Guba and Abu Qub'a (2026) that exposure alone is insufficient to overcome fossilized phonological patterns, particularly for suprasegmental features such as stress. In a related study, Alshangiti (2026) demonstrated that immersion may help shift Voice Onset Time boundaries toward more native-like patterns, but learners still require explicit training to accurately perceive relevant phonological cues.

The effectiveness of diacritics as visual support, strongly evidenced in the studies by Al Midhwah and Alhawary (2020) and Aldossari et al. (2024), can be theoretically explained through the systematicity framework proposed by Hayes-Harb and Barrios (2021). Arabic diacritics consistently represent short vowels and gemination, thereby functioning as visual cues that reinforce distinctions learners may not yet clearly perceive auditorily. However, the caution expressed by Mathieu (2015) and Shepperd et al. (2025) suggests that orthography may hinder learning when auditory contrasts are highly difficult. Therefore, a phased instructional approach appears necessary, in which auditory training either precedes or accompanies the introduction of Arabic script, especially for visually similar contrasts such as /ħ/-/χ/.

The recommendation to integrate acoustic tools such as PRAAT (Aljutaily & Almutairi, 2026) and develop corpus-based spelling correction technologies (Rytting et al., 2014) reflects current trends in technology-assisted phonological instruction. Al-Shami and Cardoso (2025) demonstrated that high-quality Text-to-Speech systems can effectively improve phonological awareness, suggesting that similar approaches may also be beneficial for Arabic language learning among English speakers. Zoghbor (2018), although focusing on Arabic speakers learning English, emphasized that pronunciation instruction should be adapted to learners' first-language backgrounds. This perspective implies that TTS systems and phonological training materials for English-speaking learners of Arabic should be specifically designed around the interference patterns identified in this SLR.

Shehata (2024) also contributed an important contextual dimension by demonstrating that learners participating in study-abroad programs outperformed at-home learners in perceiving difficult Arabic contrasts. This finding reinforces the importance of authentic and meaningful Arabic input, whether through direct immersion or through technological alternatives that provide extensive auditory exposure. However, because study-abroad opportunities are not accessible to all learners, the development of technology-based alternatives becomes increasingly important. Altakhaine et al. (2024) and Alkhateeb (2016), although examining interference in the opposite direction, provide additional comparative evidence that phonological interference is fundamentally bidirectional, meaning that pedagogical solutions may be adapted across language-learning contexts.

Overall, the pedagogical implications identified in this SLR indicate that overcoming phonological interference requires a multidimensional approach combining explicit instruction, systematic visual support, technology-assisted perception training, and rich authentic input. The finding that covert contrast represents a normal developmental stage (Aljutaily & Almutairi, 2026) also has important implications for assessment practices. Teachers should recognize that the absence of a clearly audible contrast does not necessarily indicate the absence of learning, and acoustic analysis tools may provide a more accurate understanding of learners' phonological development.

5. Conclusion

This systematic literature review demonstrates that phonological interference from English into Arabic generally appears in three major forms: difficulties in perceiving consonant contrasts that do not exist in the learners' first language, production-related errors such as hypoarticulation and covert contrast, and orthographically mediated errors resulting from differences between the Arabic and English writing systems. Among the Arabic phonological features examined, emphatic consonants, gemination, and short vowels emerged as the most vulnerable to interference. The reviewed studies employed a variety of research methodologies, including perception and production experiments, corpus-based error analysis, and quasi-experimental designs. Across the studies, the strongest pedagogical recommendations emphasized the importance of explicit pronunciation instruction, consistent use of diacritics, the integration of acoustic tools such as PRAAT, and the development of learning environments that provide rich and authentic linguistic input.

From a theoretical perspective, the findings of this SLR support major models of second language phonology acquisition, including the Speech Learning Model-Revised (SLM-r), the Perceptual Assimilation Model (PAM), and the Contrastive Hierarchy framework. These models consistently predict that

phonological features lacking direct equivalents in the learners' first language are likely to become persistent sources of interference. In addition, the orthographic framework proposed by Hayes-Harb and Barrios (2021) proved highly relevant for explaining the complex role of diacritics and foreign scripts in Arabic phonological learning. Nevertheless, several limitations of this review should be acknowledged. Although the selected studies were rigorously screened, the final corpus consisted of only eight articles, which limits the extent to which broader generalizations can be made. Furthermore, the search process relied primarily on Scopus as the main database, meaning that potentially relevant studies indexed elsewhere may not have been captured, and three potentially relevant articles could not be accessed in full text. Another limitation is that not all reviewed studies reported statistical analyses suitable for quantitative meta-analysis, resulting in a synthesis that remained entirely narrative in nature.

Several directions for future research can therefore be proposed. First, replication studies could be conducted in a wider range of geographical and institutional contexts that remain underrepresented in the current literature, such as among Arabic learners in Southeast Asia, Africa, or non-English-speaking regions of Europe. Since patterns of phonological interference may vary according to local linguistic and cultural backgrounds, broader contextual coverage would provide a more comprehensive understanding of the phenomenon. Second, similar studies could examine phonological interference in other language pairs that share related phonological characteristics, such as English interference in Hebrew, Persian, or Urdu, which also contain emphatic consonants or gemination features. Third, comparative studies involving learners from different first-language backgrounds—for example, English-speaking learners versus French-speaking learners of Arabic—could offer valuable insights into whether the interference patterns identified in this review are universal or language-specific. Importantly, these proposed research directions remain relatively practical and accessible because they do not necessarily require highly sophisticated technological resources or long-term longitudinal research designs, making them feasible for early-career researchers.

References

- Abu Guba, M. N. (2020). Gemination within English loanwords in Ammani Arabic: An Optimality-theoretic analysis. *Journal of Linguistics*, *57*(1), 1–38. <https://doi.org/10.1017/S0022226720000183>
- Abu-Guba, M. N., & Abu Qub'a, A. (2026). Acquisition of stress assignment phonology by Levantine Arabic learners of English: Evidence from nonsense words. *Social Sciences & Humanities Open*, *13*, Article 102540. <https://doi.org/10.1016/j.ssaho.2026.102540>
- Addow, A. A., Omar, S. I., & Mohamud, A. A. (2025). An analysis of phonetic and phonological systems in classical Arabic and English: A contrastive study. *Cogent Arts & Humanities*, *12*(1), Article 2549514. <https://doi.org/10.1080/2331186X.2025.2549514>
- Al-Hamad, M., & Mohamed, Y. A. (2020). An orthographic phonological-based error analysis of the Arabic of English-speaking learners. *The Language Scholar*, (6), 8–24.
- Al-Kinany, T., Al-Abri, A., & Ambusaidi, H. (2022). Phonemic perceptual relationship between English and Omani Arabic: The phonetic distance. *English Language Teaching*, *15*(2), 67–77. <https://doi.org/10.5539/elt.v15n2p67>
- Al Midhwah, A., & Alhawary, M. T. (2020). Arabic diacritics and their role in facilitating reading speed, accuracy, and comprehension by English L2 learners of Arabic. *The Modern Language Journal*, 1–21. <https://doi.org/10.1111/modl.12642>
- Al-Shami, F., & Cardoso, W. (2025). Text-to-speech in high-variability phonetic training: Focus on L2 phonological awareness. *Computer-Assisted Language Learning Electronic Journal (CALL-EJ)*, *26*(6), 42–63.
- Aldossari, A., Stevenson, R. A., & Rafat, Y. (2024). An investigation of language-specific and orthographic effects in L2 Arabic geminate production by advanced Japanese- and English-speaking learners. *Language and Speech*, 1–26. <https://doi.org/10.1177/00238309241267876>
- Aljutaily, M., & Almutairi, R. (2026). Covert contrast as a developmental stage in L2 phonology: Evidence from Arabic emphatics. *Cogent Arts & Humanities*, *13*(1), Article 2628407. <https://doi.org/10.1080/23311983.2026.2628407>
- Alkhateeb, M. M. A. (2016). My mother tongue pulls my leg: Arabic language interference in the acquisition of English language: An attempt to know how. *Journal of Education and Practice*, *7*(23), 96–101.

- Alshangiti, W. (2026). The effect of second language immersion experience on the perception of VOT by Saudi Arabic learners of English. *Languages*, *11*(5), Article 81. <https://doi.org/10.3390/languages11050081>
- Alshangiti, W., Evans, B. G., & Wibrow, M. (2023). Investigating the effects of speaker variability on Arabic children's acquisition of English vowels. *Arab World English Journal*, *14*(1), 3–27. <https://dx.doi.org/10.24093/awej/vol14no1.1>
- Altakhaineh, A. R. M., AL-Junaid, N. A., & Younes, A. S. (2024). Pronunciation and spelling accuracy in English words with initial and final consonant clusters by Arabic-speaking EFL learners. *Languages*, *9*(12), Article 356. <https://doi.org/10.3390/languages9120356>
- Archibald, J. (2022). Segmental and prosodic evidence for property-by-property transfer in L3 English in Northern Africa. *Languages*, *7*(1), Article 28. <https://doi.org/10.3390/languages7010028>
- Booth, A., Sutton, A., & Papaioannou, D. (2016). *Systematic approaches to a successful literature review* (2nd ed.). SAGE Publications.
- Brosh, H. (2015). Arabic spelling: Errors, perceptions and strategies. *Foreign Language Annals*.
- Flege, J. E., & Port, R. (1981). Cross-language phonetic interference: Arabic to English. *Language and Speech*, *24*(2), 125–146. <https://doi.org/10.1177/002383098102400202>
- Hayes-Harb, R., & Barrios, S. (2021). The influence of orthography in second language phonological acquisition. *Language Teaching*, *54*(3), 297–326. <https://doi.org/10.1017/S0261444820000658>
- Hayes-Harb, R., & Durham, K. (2016). Native English speakers' perception of Arabic emphatic consonants and the influence of vowel context. *Foreign Language Annals*, 1–16. <https://doi.org/10.1111/flan.12217>
- Mathieu, L. (2015). The influence of foreign scripts on the acquisition of a second language phonological contrast. *Second Language Research*, 1–26. <https://doi.org/10.1177/0267658315601882>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Journal of Clinical Epidemiology*, *134*, 178–189. <https://doi.org/10.1016/j.jclinepi.2021.03.001>
- Polka, L. (1991). Cross-language speech perception in adults: Phonemic, phonetic, and acoustic contributions. *The Journal of the Acoustical Society of America*, *89*(6), 2961–2977. <https://doi.org/10.1121/1.400734>
- Rytting, C. A., Rodrigues, P., Buckwalter, T., Novak, V., Bills, A., Silbert, N. H., & Madgavkar, M. (2014). ArCADE: An Arabic corpus of auditory dictation errors. In *Proceedings of the Ninth Workshop on Innovative Use of NLP for Building Educational Applications* (pp. 109–115). Association for Computational Linguistics.
- Sabbah, S. S. (2015). Negative transfer: Arabic language interference to learning English. *Arab World English Journal (AWEJ) Special Issue on Translation*, (4), 269–288.
- Schwartz, G. (2020). Asymmetrical cross-language phonetic interaction: Phonological implications. *Laboratory Phonology*, *11*(1), Article 19. <https://doi.org/10.5334/labphon.190>
- Shehata, A. (2024). Learners' perceptions of Arabic consonant contrasts: Gender and learning-context effects. *Languages*, *9*(3), Article 77. <https://doi.org/10.3390/languages9030077>
- Shepperd, L. H., Hellmuth, S., & Roberts, L. (2025). Written input and the encoding of L2 phonological contrasts: L1 Arabic learners of L2 English. *Studies in Second Language Acquisition*, 1–26. <https://doi.org/10.1017/S0272263125101514>
- Werker, J. F., & Tees, R. C. (1984). Phonemic and phonetic factors in adult cross-language speech perception. *The Journal of the Acoustical Society of America*, *75*(6), 1866–1878. <https://doi.org/10.1121/1.390988>
- Xiao, Y., & Watson, M. (2017). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, *39*(1), 93–112. <https://doi.org/10.1177/0739456X17723971>
- Zoghbor, W. (2018). Teaching English pronunciation to multi-dialect first language learners: The revival of the Lingua Franca Core (LFC). *System*, *78*, 1–15. <https://doi.org/10.1016/j.system.2018.06.008>