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Nasal Assimilation: A Contrastive Analysis of the Rules of Tajweed and the English Language Phonological System

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***Abstract*—Many Tajweed teachers struggle to teach the Tajweed to English speakers due to the learners' difficulties with Arabic's phonological system and the shortage of studies related to this area. The current paper aims to investigate the similarities and differences in nasal sounds' assimilation between the Tajweed rules and the English language and to describe how they can be applied in teaching Tajweed to non-Arabic speakers. The authors applied a descriptive qualitative design. They used note-taking to collect data from records and texts of both languages to analyze the data contrastively. The results revealed striking similarities and significant distinctions between both languages. For the similarities, nasal assimilation is influenced by the proximity of the place of articulation. Besides, in both languages, nasal sounds assimilate partially, completely, or disassimilate based on the phonetic features of the following sound. Regarding the differences, the ghunnah is held for two counts in Tajweed rules, while in English, it is not. Additionally, the ghunnah is emphasized before emphatic sounds in the Tajweed. However, nasal assimilation in English occurs clearly in spontaneous speech. On this basis, this paper assists teachers by using the results to predict learners' areas of difficulty and ease. Furthermore, it helps learners understand this phenomenon.**

***Index Terms*—contrastive analysis, nasal sounds assimilation, methodology, Tajweed rules, English**

I. Introduction

One of the common phenomena across languages is assimilation, as in Korean (Kochetov & Pouplier, 2008), English (Coetzee, 2016), and Classical Arabic (CA) (ElBehiry, 2024). It refers to the influence of the characteristics of one sound on the adjacent sound to be similar or identical in the place or manner of articulation (Davenport & Hannahs, 2013). It appears in both English and Arabic as a main phenomenon of speech. In Arabic, it plays an essential role in reciting the Holy Qur'an accurately. Tajweed rules refer to the rules of reciting the Qur'an correctly by pronouncing each sound from its correct place with accurate phonological processes (Kareema, 2008).

One of the main types of assimilation is nasal assimilation. It occurs in CA in the Holy Qur'an, such as in {مِن بَعْدِ} 'after' (Al Baqarah, 2:27), the /n/ partially assimilates to the next bilabial stop /b/ (Abalkheel, 2016). This type of assimilation in the Tajweed rules presents the effect of the phonetic characteristics of adjacent sounds (Alsurf, 2012). Similarly, the nasal /n/ partially assimilates to the next bilabial stop /p/ in the English word /ɪnpʊt / 'input' (Carr & Montreuil, 2013).

According to Alfozan (1989), assimilation can be categorized into three main types based on the direction of influence: progressive assimilation, regressive assimilation, and reciprocal assimilation. Progressive assimilation occurs when a segment is affected by a preceding sound, as in 'bags,' to be pronounced as /bægz/, where the voiced feature of /g/ affects the voiceless /s/ to be pronounced as its voiced counterpart /z/. In contrast, regressive assimilation happens when a segment is affected by the following sound (al-Hashmi, 2004), like 'can' is pronounced as /cæ̃n/ where the nasalization feature is shared with the preceding vowel. Finally, reciprocal assimilation refers to assimilation in both directions.

Many Tajweed tutors who teach the Tajweed rules to English speakers struggle because their students are not familiar with the phonological system of the Arabic language. The researchers observed the teachers' problems in teaching the Tajweed and the learners' difficulties with its understanding and production, particularly with nasal assimilation. Consequently, this study aims to present a contrastive analysis of the assimilation of the nasal sounds: /n/ and /m/ in the Tajweed rules and English, how they are similar and different, and how these points can help instructors teaching the Tajweed for English speakers, which leads to enhance their understanding of this phenomenon in the Tajweed rules. Additionally, it allows tutors to predict their learners' areas of difficulty.

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Learning the relationship between phonological features in different languages leads to producing them easily and effectively. For example, Elebiarie (2021) investigated the relationship between studying the Tajweed and English pronunciation, particularly examining Tajweed's effect on the English language production of assimilation. The data were analyzed using Praat software. The study indicated that learning Tajweed rules for children positively affected their production of English assimilation. Additionally, Elebiarie (2023) applied the study to adult second language learners, which similarly improved their production of English assimilation.

These findings prove the relationship between this phonological phenomenon in both Arabic and English. Consequently, identifying the similarities and differences between nasal assimilation eases learning Tajweed rules for non-Arabic speakers, particularly English speakers. This study adds to the Qur'anic studies and comparative linguistics by clarifying how these two languages differ and share some aspects regarding this phonological process.

The current study aims to identify the similarities of the nasal sounds /n/ and /m/ assimilation in Tajweed rules and English and to explore how nasal assimilation differs between these two systems. Additionally, it seeks to clarify how these points can help teachers of non-Arabic Qur'an learners.

The study attempts to answer the following questions:

1. What are the similarities and differences between the nasal sounds /n/ and /m/ assimilation in the Tajweed rules and the English language?
2. How are the similarities and differences applied to teach assimilation of the Tajweed rules?

II. Literature Review

A. Nasal Assimilation in English

English nasal sounds are /n/, /m/, and /ŋ/. The nasal /n/ is described as a voiced alveolar nasal stop, /m/ is a voiced labial nasal stop, and /ŋ/ is a voiced velar nasal stop. Typically, nasal sounds are influenced by the features of the following consonant. According to Kawahara and Garvey (2014), nasal sounds have less distinct acoustic cues than oral stops, which leads them to assimilate to the following sounds. For example, /n/ assimilates to /ŋ/ when it is followed by a velar stop sound, like /k/ or /g/ (Ladefoged & Johnstone, 2015). The phonemes of the English language are presented in the following table.

TABLE 1
THE PHONEMIC INVENTORY OF ENGLISH CONSONANTS (ROACH, 2004, P. 240)

	Bilabial	Labiodental	Dental	Alveolar	Post-alveolar	Palatal	velar	Glottal
Plosive	p b			t d			k g	
Affricate					ʧ ʤ			
Nasal	m			n			ŋ	
Fricative		f v	θ ð	s z	ʃ ʒ			h
Approximant	(w)				r	j	w	
Lateral approximant				l				

According to Cohn (1993), there are three degrees of assimilation in English: full nasal production, partial assimilation, and complete assimilation (deletion). Nasal sounds can completely assimilate to the following consonant, leading to nasal deletion, as in sent /sɛnt/ [sɛ̃t]. The complete assimilation of the nasal /n/ happens because of the following voiceless alveolar stop where the phonological feature [+ nasal] moves to the preceded vowel. The degree of assimilation depends on the characteristics of the preceded vowel and the following consonant. However, assimilation is categorical process that differs across speakers in casual speech.

Hon (2005) conducted an acoustic study on the assimilation of the coronal and labial nasal sounds /n/ and /m/ across word boundaries. Hon used recordings from native American English speakers. The researcher argues that this phenomenon occurs in conversational speech, where the participants clearly produced nasal assimilation of the targeted words. Besides, the values of F2 of vowels differ between the coronal nasal /n/ and the labial nasal /m/. In addition, assimilation has degrees that differ between speakers, consistent with Cohen's (1993) results.

Dilley and Pitt (2007) conducted a phonetic and acoustic study on analyzing word-final segments, /t/, /d/, and /n/ assimilation to the following velars /k/ and /g/ or labials /p/, /b/, and /m/. The researchers utilized a corpus of native English speakers from Columbus, Ohio. The results showed that the percentage of complete assimilation is low in these phonetic environments. According to acoustic analysis, assimilation is categorical in spontaneous speech, occurring in complete, near-complete, partial, or not assimilated forms, consistent with the findings of Cohen (1993) and Hon (2005).

Similarly, Coleman et al. (2016) conducted a study to prove the existence of non-alveolar /m/ and /ŋ/ assimilation in British English. The researchers collected the data from male and female native British English speakers. They concentrated on word-final nasal assimilation with word-initial oral consonants and analyzed them using Praat software. The findings proved that non-alveolar nasal sounds assimilate clearly to the following oral consonant based on F2 changes. Since they are all velars, the /n/ and /m/ assimilate to /ŋ/ before /k/ and /g/. Similarly, when /n/ and /ŋ/ are followed by a labial sound, they assimilate to /m/ because of the shared place of articulation. On the other hand, when /m/ and /ŋ/ are followed by /t/ or /d/, they assimilate to /n/. Moreover, nasal sounds do not assimilate before vowels. Consequently, all three nasal sounds, /n/, /m/, and /ŋ/ in English assimilate to the following oral consonants based on their place of articulation. However, the researchers analyzed only nasal sounds when stops followed them.

Rydzewski (2023) used the underspecification and optimality theory frameworks to analyze nasal assimilation in English. The data included assimilation within words and across word boundaries. The study proved that, in casual speech, the /n/ is the only nasal that assimilates to the following stop while /m/ and /ŋ/ do not, which disagrees with the results of Coleman et al. (2016).

Overall, the literature on English nasal assimilation proved that it happens naturally in casual speech. Besides, there are three degrees of assimilation, complete, partial, and no assimilation, that differ across speakers (Cohn, 1993; Hon, 2005; Dilley & Pitt, 2007). However, the studies focused on assimilating nasal sounds to the following stop consonants without considering affricates and fricatives.

B. Nasal Assimilation in Tajweed Rules

Classical Arabic (CA) is the Arabic of the Holy Qur'an, Prophet Mohammad's sayings, and ancient poetry. It is a prestigious language with unique linguistic features (Fischer, 2005). The phonemes of CA are presented in the following table.

TABLE 2
THE PHONETIC INVENTORY OF CLASSICAL ARABIC CONSONANTS (MUSTAFAWI, 2018, P. 12)

	Bilabial	Labiodental	Dental	Alveolar	Post-alveolar	Palatal	velar	Uvular	Pharyngeal	Glottal
Plosive	b			t d tˀ dˀ			k	q		ʔ
Affricate					ʤ					
Nasal	m			n						
Fricative		f	θ ð ðˀ	s z sˀ	ʃ			χ ʁ	ħ ʕ	h
Approximant					r	j	w			
Lateral approximant				l						

Arabic has two nasal sounds: the voiced alveolar nasal stop /n/ and the voiced bilabial nasal stop /m/, and they are affected by the following sounds within words and across word boundaries, depending on the phonetic characteristics of the following consonant (Kareema, 2008). For nasal assimilation, the nasal sounds /n/ and /m/ should be quiescent or have a nunation (a definiteness marker), while the following consonant should not. Moreover, nasal assimilation occurs before particular sounds (ElBehiry, 2024).

Alfozan (1989) studied the assimilation of the nasal /n/ and its types in CA. Alfozan stated that the /n/ assimilates completely or partially to most of the consonants in CA. Complete assimilation occurs when /n/ is followed by /m/, /l/ or /r/ across word boundaries. Still, the /l/ and /r/ are not nasalized like /m/, for example, {مِّن لَّدُنَّا} 'from us' while partial assimilation occurs with the /j/ and /w/ across word boundaries. Nasal assimilation with the preceded sounds is called Idgham. In contrast, /n/ partially assimilates when it is followed by /b/ to be pronounced as /m/ within words and across word boundaries. That is called Iqlab. Additionally, it partially assimilates to /f/, /θ/, /ð/, /ðˀ/, /t/, /tˀ/, /d/, /dˀ/, /s/, /z/, /sˀ/, /ʤ/, /ʃ/, /k/, and /q/, this type is called Ikhfa. Alfozan found that /n/ changes its place in partial assimilation based on the place of articulation of the following sound while it dissimilates when it is followed by /χ/, /ʁ/, /ħ/, /ʕ/, /ʔ/, and /h/, that is Idhar.

Al-Hashmi (2004) adds to the work of Alfozan (1989) by specifying the resulting sounds of nasal assimilation. The /ŋ/ sound replaces the /n/ when it is followed by the velar /k/, /ɲ/ before palatals /ʤ/ and /ʃ/, /n/ before /t/, /tˀ/, /d/, /dˀ/, /s/, /z/, /sˀ/, /ɱ/ before dentals /θ/, /ð/, /ðˀ/, /w̃/ before the labio-dental /f/, and /ɴ/ before the uvular /q/. The researcher also classified the sounds into natural classes, which is consistent with Abalkheel's (2016) analysis of the natural classes of the following sounds' effect on the nasal /n/. /n/ dissimilates when gutturals follow it, while it partially

assimilates when a plosive follows it. Besides, /n/ completely assimilates to sonorant consonants when they follow it, while it partially reciprocally assimilates with glides.

ElBehiry (2024) adds to the Arabic studies by analyzing the assimilation of /m/. /m/ assimilation has three main categories: complete assimilation, Idgham Shafawi, when it is followed by /m/, while if it is followed by the bilabial /b/, Ikhfa Shafawi, it is pronounced with keeping the lips together with preserving the nasality. The third type is Idhar Shafawi, with no assimilation, where the /m/ dissimilates when other consonants follow it.

Most studies agreed on analyzing the nasal /n/ place assimilation (Alfozan, 1989; al-Hashmi, 2004; Abalkheel, 2016), while short studies analyzed /m/ assimilation (ElBehiry, 2024). Al-Hashmi (2004) is the only one who used international phonetic alphabet (IPA) symbols to describe the resulting sounds of nasal assimilation. Studies in Arabic literature have analyzed nasal /n/ assimilation from different angles, while /m/ assimilation requires further analysis.

C. Contrastive Studies of Nasal Assimilation in English and Tajweed Rules

Ali (2012) contrasted Arabic assimilation with English to determine whether the assimilation of sounds in English and Idgham in the Tajweed is the same and to investigate the similarities and differences between assimilation in both languages. For the findings, Ali argued that English assimilation is not a precise equivalent of the Arabic Idgham. Additionally, in Tajweed, /m/ is deleted when it comes before /b/, while in English, /b/ is hidden when it comes before /m/. Besides, Ali argues that assimilation in Tajweed is more diverse than in English. However, assimilation, regressively and progressively, happens to consonants and vowels in both languages.

Similarly, Salih (2012) conducted a contrastive study to provide a deep understanding of assimilation in Arabic and English. The results showed that there are some common points between them. First, it occurs between sounds at word boundaries. Also, it happens according to the similarity of the phonetic features between neighboring sounds, whether in place or manner of articulation. For the differences, in English, the assimilated sounds result in a different sound that is a blend of the two, while in Arabic, sounds are influenced and tend to resemble the adjacent sound. In addition, English assimilation occurs both regressively and progressively, whereas, in Arabic, it appears to occur progressively, which is inconsistent with the findings of Ali (2012).

Madia (2017) analyzed nasal /n/ assimilation in CA and English using Surah Al-Baqarh for Arabic and CNN, a TV news channel, as a source for English applying the note-taking method. Madia found that /n/ assimilates to /m/ when it is followed by /b/, as Alfozan (1989) stated. Additionally, there is no /n/ assimilation when it is followed by /s/, /t/, and /d/ in English while it occurs in CA. CA has 21 phonemes that affect the /n/, while in English, there are only 13 phonemes.

Eltaif (2019) reported on assimilation and other phonological components in Tajweed and English as shared phonological features. The results indicated that assimilation in English and Tajweed rules share only one point in common: regressive assimilation at word boundaries, which is inconsistent with the findings of Ali (2012) and Salih (2012).

In the previous studies, there were variant findings. Some researchers have highlighted the differences between assimilation in Tajweed and English, as noted by Ali (2012), Madia (2017), and Eltaif (2019). On the other hand, other researchers have investigated many shared points, such as Salih (2012). Moreover, the studies focused exclusively on the assimilation of the nasal /n/ with other phonological processes. Tajweed learners should understand Nasal assimilation phonetically and phonologically to produce it correctly. Thus, there is a need for a comprehensive study that analyzes the relationship between the pronunciation, duration, and the clues of nasal assimilation in the diacritics of the Holy Qur'an and English.

III. Methodology

A. Research Design

This study aims to investigate the similarities and differences between the assimilation of nasal sounds /n/ and /m/ as articulated in the Tajweed rules and English phonology, intending to facilitate non-Arabic speakers' acquisition and accurate recitation of the Qur'an. A qualitative research design was chosen to provide an in-depth understanding of the phenomenon, enabling a comprehensive cross-linguistic comparison (Creswell, 2014).

The primary analytical framework used in this research is contrastive analysis, a method that systematically explores the relationships between languages by identifying their phonological similarities and differences. This comparative linguistic approach plays a critical role in language acquisition, particularly in teaching pronunciation and phonological features to second language learners (Krzeszowski, 2011).

A subfield within this framework is contrastive phonology, which focuses on identifying and comparing specific phonological features across languages (Ke, 2018). Recognizing both the commonalities and distinctions in phonological structures enables learners to transfer relevant phonetic knowledge from their first language (L1) to a second language (L2), thereby facilitating more effective language acquisition (Fisiak, 2011).

B. Data Collection Method

To ensure a precise comparison of nasal assimilation between English and Tajweed, the data for Qur'anic recitation were sourced from recordings by the renowned reciter Ibrahim Al-Akhdar, available through the King Fahd Glorious

Qur'an Printing Complex Corpus (KFGQPC, 2021). Al-Akhdar's recitation style, known as Al-Tahqiq, was selected because it is widely regarded as the most suitable method for instructional purposes. Al-Tahqiq is characterized by deliberate and accurate articulation, which ensures clear pronunciation of phonemes, particularly the nasal sounds, and proper timing of the ghunnah (nasalization) in Qur'anic recitation (Al-Hashmi, 2004).

For English, the data were drawn from the Buckeye Speech Corpus (Pitt et al., 2006), which includes recordings of native English speakers from Columbus, Ohio. Selected Qur'anic verses and English lexical items of the records were analyzed to extract phonological rules and to provide a comparative examination of nasal features across Arabic and English.

Instrument for Data Collection: The primary instrument used for data collection in this study was note-taking, a method that allowed for a focused and systematic examination of nasal assimilation. The notes were derived from the analysis of Qur'anic recitation by Al-Akhdar (KFGQPC, 2021) and the Buckeye Speech Corpus (Pitt et al., 2006), which enabled the detailed identification of nasal assimilation types and the corresponding phonological rules governing the process in each language.

C. Data Analysis Method

The analysis followed a structured process. First, a detailed examination of nasal assimilation was conducted for each language independently, identifying the various types of nasal assimilation and the phonological rules involved, which included analyzing the phonetic features in the context of Tajweed and English separately.

Once the nasal assimilation rules for each language were identified, the second stage of analysis focused on comparing the similarities and differences between the two languages. Special attention was given to how nasal assimilation is applied differently in the context of Qur'anic recitation in Arabic (Tajweed) and English phonology.

Finally, the last stage of the analysis aimed to interpret how the similarities and differences in nasal assimilation between English and Tajweed can inform the pedagogical application of Tajweed principles, particularly in teaching these phonological features to non-Arabic speakers. This analysis will provide valuable insights for instructors to help their students better understand and accurately produce nasal assimilation in Tajweed recitation.

IV. Results and Discussion

A. Similarities in Nasal Assimilation Between English and Tajweed Rules

The analysis of recorded data and texts reveals several noteworthy similarities in the processes of nasal assimilation in English and Tajweed phonological rules:

Occurrence Across Word Boundaries and Within Words: For most sounds, nasal assimilation in English and Tajweed can occur within single words and across word boundaries. For instance, in English, the assimilation of /n/ to the dental /θ/ appears in words such as month /mʌnθ/ and fifteen thousand /fɪftiːnθaʊzənd/, while in the Quran, examples include{ أُنثَىٰ}'female' (Aal-i-Imraan, 3:36), and { مِن ثَمَرَةٍ }'of fruit' (Al-Baqarah, 2:25).

Partial Assimilation Before Oral Stops: In both languages, the nasal /n/ tends to undergo partial assimilation when it is followed by oral stops, excluding the glottal stop /ʔ/ in Arabic. Assimilation happens since many oral stops have close places of articulation to /n/ at the alveolar ridge. However, the glottal /ʔ/ is produced further back in the glottis, making assimilation less likely to happen. This general pattern of assimilation based on articulatory closeness contradicts Madia (2017), who claimed that /n/ does not assimilate when it is followed by /t/ or /d/ in English.

Assimilation Before Glides: The nasal /n/ merges with glides to form nasalized glides such as /w̃/ and /j̃/. These glides behave similarly to vowels, adopting nasalization and coalescing with /n/, resulting in a single phonetic unit, nasalized glide.

Assimilation with Fricatives: The nasal /n/ undergoes partial assimilation with fricatives in both languages, excluding /h/ in both, and additionally /ħ/, /ʁ/, /χ/, and /ʕ/ in Arabic. As with stops, fricatives that share articulatory proximity with /n/ are more likely to trigger assimilation.

Assimilation Between Nasal Sounds: When /n/ is followed by /m/, a geminated /m/ is produced, reflecting complete assimilation. This gemination is due to the shared nasality feature. Similarly, /n/ followed by /n/, or /m/ followed by /m/, results in complete assimilation and is realized as a single geminated nasal.

B. Differences in Nasal Assimilation Between English and Tajweed Rules

Despite several shared features, key distinctions exist between the two systems:

Assimilation to Liquids /l/ and /r/: In English, /n/ undergoes partial assimilation to the following /l/ and /r/, as in online /ɑːnlaɪn/. However, in Tajweed, the assimilation is complete, as in { مِّن لِّينَةٍ } 'of palm' (Al-Hashr, 59:5), where ghunnah is lost and the following liquid becomes geminated. Notably, this type of assimilation occurs only across word boundaries in Arabic.

Assimilation Before Emphatic Sounds: In Arabic, emphatic consonants /q/, /sˁ/, /dˁ/, /tˁ/, and /ðˁ/ take the nasalization feature, ghunnah, from /n/ and simultaneously add emphasis upon it, producing a uniquely strong nasal resonance. This process is exclusive to Arabic, as English lacks such emphatic phonemes.

Limited Range of /m/ Assimilation: In English, /m/ partially assimilates to the labial sounds: /b/, /p/, and /f/, whereas Tajweed partially assimilates to the bilabial /b/ only. In both systems, this assimilation is restricted to labials, aligning

with the findings of Dilley and Pitt (2007), Coleman et al. (2016), and Rydzewski (2023). Contrary to Salih (2012), /m/ is not deleted before /b/ but instead assimilated partially in the Tajweed. Similarly, /n/ followed by /b/ may sound like /m/ but without complete lip closure.

Length of Nasalization: In Quranic recitation, the ghunnah is held for two counts, ensuring clear and prolonged nasalization. English speakers, however, do not produce such temporal constraints, resulting in shorter or more variable nasal durations.

Assimilation Restrictions Based on Place of Articulation: In Tajweed, /n/ does not assimilate when it is followed by /ʔ/, /h/, /ħ/, /ʁ/, /χ/, or /ʕ/, due to their far place of articulation from the nasal /n/ and /m/. In English, /n/ does not assimilate only before /h/ for the same reason: the glottal articulation of /h/ makes nasal assimilation unfeasible.

Orthographic Indicators in Arabic: In Tajweed, nasal assimilation is marked orthographically. When a nasal consonant lacks a sukun (diacritic), it signals assimilation. For instance, in {مِن بَعْدِ} 'after' (Al-Baqarah, 2:27), the /n/ lacks a diacritic, whereas in {مِنْهَا} 'thereforme' (Al-Munaafiqoon, 63:8) it retains one, indicating no assimilation. However, the presence or absence of nunation (tanween) can signal assimilation depending on the nature of the following consonant, whether it is a sound to which nasal assimilation typically applies. English, by contrast, provides no orthographic cues for nasal assimilation.

Dependence on Speech Style: In both systems, nasal assimilation is conditioned by speech context. Tajweed prefers Altahqiq, a precise and clear recitation, which ensures an accurate phonological representation for learning it. Conversely, English nasal assimilation occurs more in spontaneous or casual speech, where articulation is more relaxed.

Classification of Assimilation Types: Tajweed rules categorize nasal assimilation into four distinct types: Ikhfa, Idgham, Iqlab, and Idhar. English, however, employs a simpler framework: complete assimilation, partial assimilation, and no assimilation, which is consistent with Ali's findings (2012).

C. Applying the Findings for Teaching Tajweed Rules for Non-Arabic Speakers

The results of this study can enhance teaching Tajweed to native English speakers by focusing on the similarities and differences between nasal assimilation in both languages. Since English speakers are already familiar with nasal assimilation patterns, particularly with nasal sounds /n/ and /m/ to other sounds, this allows Tajweed teachers to build on their knowledge in teaching Tajweed rules. By highlighting the systematic nature of Tajweed's nasal assimilation rules, such as the role of orthographic diacritics and the distinction between partial and complete assimilation, English speakers can more easily learn when and how to produce nasal assimilation in Tajweed and understand the significance of precise articulation in Quranic recitation.

Additionally, by comparing the nasal assimilation processes in English and those in Tajweed, tutors can encourage learners to practice more focused recitation, such as Altahqiq recitation, to ensure proper and precise production of the nasalization process. Besides, instructors can use these findings to predict areas of ease and difficulty their students may encounter. Typically, integrating the results of this study into pedagogical methods enhances the clarity and accuracy of Tajweed rules production for English-speaking learners, making the learning process more accessible and easier.

V. Conclusion

This contrastive analysis of nasal assimilation in English and Tajweed reveals both remarkable similarities and noteworthy distinctions shaped by linguistic, phonological, and orthographic principles. In both languages, nasal assimilation is influenced by the proximity of the place of articulation, with assimilation occurring in varying degrees, partial, complete, or none, depending on the phonetic characteristics of the following segment. While English nasal assimilation is largely shaped by phonetic environments in spontaneous speech, leading to variable degrees of assimilation across different speakers, Tajweed assimilation follows a much more structured and systematic set of rules governed by precise recitation guidelines. Additionally, Tajweed's nasal assimilation is marked by specific orthographic cues, which are absent in English.

A key distinction between the two systems lies in the higher degree of phonological regulation in Tajweed. Unique features such as emphatic sound effects, the clear categorization of assimilation types (Ikhfa, Idgham, Iqlab, and Idhar), and the explicit temporal requirement for ghunnah (nasalization) underscore the disciplined and methodical nature of Tajweed's phonological rules. In contrast, English exhibits more flexible and less regulated nasal assimilation, with fewer constraints on the phonetic environments in which it occurs.

While this study offers a valuable theoretical and auditory examination of nasal assimilation in both languages, it is primarily descriptive and lacks empirical methods, such as production or perception experiments, to further validate the findings. Therefore, future research utilizing experimental approaches is crucial to assess how consistently nasal assimilation is realized and interpreted across different speakers and linguistic contexts. Experimental studies could investigate the production of nasal assimilation in both languages under controlled conditions, providing a deeper understanding of how these processes function in real-world speech and their implications for language teaching.

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