Journal of Language Research
ZABANPAZHUHI

Journal of Language Research, *Alzahra University*
Vol. 16, No. 53, Winter 2025, pp.97-118
Research Article

An optimality theoretic-based analysis of consonant cluster pronunciation errors among Iraqi EFL learners

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Received: 2024/08/05 Accepted: 2024/10/13

Abstract

This study examines the pronunciation errors of English consonant clusters among Iraqi EFL learners through the lens of Optimality Theory (OT). For this aim, 40 first-year university students of different majors aged 18-25 years were selected from beginner and lower-intermediate levels based on their scores on Oxford Placement Test. Using different instruments, such as reading instruction and read-aloud test, and being informed from the category of major pronunciation problems by Arabic learners presented by Yavaş (2011), an Optimality Theory-based analysis was adopted in the research. Findings indicated that in pronouncing initial clusters of two consonants, *COMPLEX onset as the high-ranked constraint is frequently violated in Iraqi Arabic (IA), because in IA there are many words started with #CCV. Also, *#CCC is never violated in IA. Since constraints are universal, languages differ only in how they rank them. In pronouncing a coda cluster consisting of two consonants, although *CCcoda is never violated in IA, this constraint is not permuted in the pronunciation of the participants. However, to pronounce words with the structure of VCCC(C)#, it seems that the two low-ranked constraints, namely *CCCCcoda and *CCCcoda in English are permuted to high-ranked constraints in the pronunciation of IA learners.

Keywords: pronunciation errors, consonant clusters, Iraqi EFL learners, constraint ranking, optimality theory

How to Cite:

Naseri, Z; Ahmadinasab, F; Kadhim Jawad, R (2025), An optimality theoretic-based analysis of consonant cluster pronunciation errors among Iraqi EFL learners, *Journal of Language Research*, 16 (53), 97-118.

https://doi.org/10.22051/jlr.2024.47947.2470 homepage: https://zabanpazhuhi.alzahra.ac.ir

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1. Introduction

An essential element of effective communication is proper English pronunciation, which serves as the foundation for intelligibility among speakers. However, non-native English speakers may encounter difficulties when conversing with native speakers (Altaha, 1995). Lado (1957) notes that these issues are especially common when the learners' native languages are linguistically very different from English. Pronunciation differences and challenges have made phonological error analysis a significant area of interest for researchers (Yavas, 2011; Majeed, 1999; Bauman-Waengler, 2004). Mastering another language necessitates the ability to use it correctly, which involves understanding its phonetic system (Al-Abdely & Thai, 2016). Proper recognition and production of the phonemes in a new language are crucial for successful pronunciation (Baker, 2006). For EFL Arab students, difficulties in English pronunciation are evident due to the differences in the sound systems of Arabic and English, such as the place of articulation (Altamimi, 2015).

Optimality Theory (OT) is one of the recent theories applicable to the analysis of phonological errors. Introduced by Prince and Smolensky (1993) as an alternative to rule-based phonology, OT posits that a form is influenced by a hierarchy of constraints, either faithfulness or markedness/well-formedness constraints (Alezetes, 2007). Faithfulness constraints ensure that the output remains true to the input, whereas well-formedness constraints allow for less marked outputs (Alezetes, 2007). The hierarchy of these constraints determines which constraints are more violable (Galal, 2004). Typically, the optimal form will violate constraints that are ranked lower in the hierarchy or are less frequently violated in higher hierarchies (Galal, 2004). The optimal output comes from the constraints in the competence of language users; according to OT, at the universal level, there are groups of constraints on phonological representations (CON stands for Constraints); moreover, it is possible to make relation between an actual input and all potential outputs (GEN stands for the Generator), and finally, the optimal output will be selected based on simultaneous evaluation of the potential outputs based on ranked constraints (EVAL stands for Evaluator) (Archangeli, 1999). To accomplish these processes, two different constraint families, called Faithfulness and Markedness are important (Kager, 1999). Kager (1999) defined the terms as two forces that are involved in a basic conflict in each grammar. The Markedness constraint groups (e.g. ONSET, NOCODA, and *COMPLEX) evaluate the output to prevent producing marked and complex forms (Kager, 1999). Markedness constraints can be violated (Blevins, 1994). On the other hand, faithfulness constraint families evaluate output concerning input to seek identical representation between their forms (McCarthy & Prince, 1995). Faithfulness has three sub-constraints, called, MAX IO (maximize the input), DEP IO (output depends on input), and IDENT; these sub-constraints acknowledge the output parts which are the same as the input and each one of these constraints benefit from certain segment prohibition (McCarthy & Prince, 1995).

Based on the constraint ranking in Optimality Theory (OT), the present study aims to reveal the strategies and simplification techniques employed by Iraqi EFL learners to overcome difficulties with English consonant clusters. Additionally, the study seeks to determine whether OT can enhance the quality of teaching and learning pronunciation.

2. Literature Review

Optimality Theory (OT), as a framework for understanding language knowledge and acquisition, has garnered significant attention in the field of L2 language acquisition (e.g., Hancin-Bhatt & Bhatt, 1997). Researchers have applied OT to L2 phonological acquisition to explain various phonological errors, including studies by Broselow et al. (1998). For example, Al-Yami and Al-Athwary (2021) explored the pronunciation difficulties of specific English consonant clusters (CCs) encountered by Saudi EFL learners. Their OT analysis indicated that onset clusters were predominantly affected by L1 ranking constraints, while coda clusters were more influenced by universal Markedness constraints. The study found that the tendency to prioritize Markedness constraints over Faithfulness constraints led participants to employ simplification strategies. Similarly, Al-Jarrah (2002) utilized OT to analyze how

Arab native speakers learn English word stress. The study reported that some Arab English learners struggled with English stress patterns, and these difficulties were attributed to failures in adhering to the correct ordering of universal and violable constraints, as outlined by OT.

Several non-Arabic studies have also applied Optimality Theory (OT) to analyze pronunciation errors in English learners. Usman and Kagu (2021) examined the articulation patterns of English consonant clusters by Nigerian broadcasters, comparing their pronunciation to Received Pronunciation. They found that participants used epenthetic vowels to break up onset consonant clusters and employed consonant deletion to simplify coda clusters.

Liu (2021) used both empirical and theoretical methods to analyze the acquisition of English sentence stress through OT. Their study aimed to address issues related to the mispronunciation of English sentence stress.

Razmdideh and Naseri (2020) conducted a descriptive-analytic study to investigate the substitution of English consonants with their Persian counterparts. Their analysis focused on the constraints and rankings of OT to minimize interference during later stages of language learning.

Torabi and Jabbari (2018) investigated how Persian-speaking learners' background affects their acquisition of English primary stress patterns, considering two recent transfer hypotheses: Failed Functional Feature and Prosodic Transfer. Similarly, Ghorbanpour et al. (2019) explored syllable adaptation in Persian loanwords, particularly tetrasyllabic words, using OT. They noted that Persian avoids consonant clusters in the onset position, leading to adaptations of borrowed words to fit Persian syllable structures.

Yeh (2022) analyzed strategies employed by Taiwanese elementary school children for pronouncing English obstruent-obstruent clusters, such as schwa [ə] insertion or obstruent deletion, using OT. Nguyen (2019) applied OT to explore techniques used by Vietnamese L1 speakers for pronouncing final English consonant clusters.

According to Al-Hamash (1985), many Arab learners of English struggle with pronouncing English clusters, making this area a significant focus for the current study. Previous research has utilized contrastive analysis (e.g., Alezetes, 2007) and Gilbert's Prosody Pyramid (e.g., Bin-Hady, 2016) to examine pronunciation errors among Arab English learners. However, to the best of the authors' knowledge, the application of Optimality Theory (OT) to analyze pronunciation errors among Iraqi EFL learners remains unexplored.

Furthermore, while various studies have investigated pronunciation errors of EFL learners across different countries and languages—such as Ababneh's (2018) study on Saudi students and Jabbari and Fazilatfar's (2012) research on Persian EFL learners-there is a noticeable lack of studies focusing on Iraqi learners. This gap in the literature prompted the decision to conduct the present study.

3. Methodology

The participants of the present study were 40 first-year university students from the University of Basra, comprising 20 males and 20 females, aged between 18 and 25 years. Participants were chosen from beginner and lower-intermediate levels based on their scores on the Oxford Placement Test (OPT). Specifically, students with OPT band scores below 50 were selected for the study. All participants were native speakers of Iraqi Arabic.

This study utilized several instruments, including reading instruction, a read-aloud test, and the OPT. According to Jackson et al. (2016), employing various instruments and procedures in research can enhance internal validity and support cross-validation, leading to more precise and reliable results. In addition to these instruments, the authors incorporated extra words and sentences to further ensure the reliability of the pronunciation error analysis.

For the reading instruction component, participants were asked to read two short texts aloud: "How Do Hearing-Impaired People Talk?" and "Rice", extracted from the fourth edition of *Reading and Vocabulary Development 1: Facts and Figures* by Ackert and Lee. These texts were chosen based on the reason that they were designed for elementary and lower-intermediate learners, featuring core vocabulary appropriate for their reading level. Additionally, the texts were selected to engage participants and facilitate the data collection process by encouraging them to read aloud more comfortably.

In the read-aloud test, the participants were required to read 42 selected words aloud within 15 minutes. Each test was conducted and recorded individually in a quiet room. The words were presented in a randomized order on a sheet to minimize sequencing effects. Participants were informed before the test that the recordings were solely for the study, their anonymity would be maintained, and their performance would not impact their university courses. All sessions were conducted individually in a quiet classroom at the Department of Language at the University of Basra.

After selecting participants with beginner and lower-intermediate proficiency levels based on their OPT scores (below 50), they were asked to read the texts and words during the read-aloud practice in a quiet room. Their pronunciations were recorded and transcribed using the International Phonetic Alphabet (IPA). The collected data were categorized and sub-categorized according to major pronunciation problems identified by Yavaş (2011), with some modifications by the authors:

1. Onset and coda clusters:
   I. Onset clusters:
      A. consisting of two consonants (/**pl**eɪ/)
      B. consisting of three consonants (/**str**ʌk.tʃər/)
   II. Coda clusters:
      A. consisting of two consonants:
         a. nasal- stop (/læ**nd**/)
         b. lateral- stop (/mɪ**lk**/)
         c. lateral- nasal (/fɪ**lm**/)
         d. fricative- stop (/æ**sk**/)
         f. stop- s/z (/kæ**ts**/)
      B. consisting of three / four consonants:
         a. CC-s/z (/kæ**mps**/)
         b. CC-stop (/tɛ**kst**/)
         c. CCCC (/tɛ**ksts**/)
2. Heterosyllabic obstruent-obstruent in multisyllabic words

(/sɛ**p.t**ɛm.bər/)

Subsequently, two to three words were selected from each category and related sub-category. Constraints were ranked according to the processes observed in the optimal candidate, and an optimality tableau was designed for the selected data. The authors then analyzed each tableau to identify the phonological processes involved in the different types of pronunciation errors.

4. Results and Discussion

Learners encountered significant difficulties with the pronunciation of initial consonant clusters. As shown in Table 1, their major issue was with the #CCC clusters, which are absent in Iraqi Arabic (IA). Consequently, transfer from their mother tongue was evident, often manifesting as prothesis or epenthesis. For example, to pronounce such non-existent features, Iraqi learners used strategies like inserting the /ɪ/ sound, resulting in pronunciations like [ɪs.tɪ.rʌk.tʃər] or [sɪ.tɪ.rʌk.tʃər] for [strʌk.tʃər].

Table 1.

Frequency and percentage of the participants mispronouncing initial consonant clusters

Type of initial cluster	Frequency of mispronouncing participants	Percentage of mispronouncing participants
#fricative or plosive+ liquid	6	15%
#/s/+ voiceless stop	30	75%
#/s/ + liquid or nasal	10	25%
#CCC	40	100%

Regarding VCC# clusters, learners did not face significant problems because the syllabic structure of Iraqi Arabic (IA) in the coda position is VCC#, allowing them to positively transfer this feature to English. Abdul Sattar (2015) noted that in Iraqi Arabic, the CVCC pattern occurs in word-final positions and in monosyllabic words. However, learners struggled with V-stop-stop# clusters, with a notable difficulty rate of 27.5%. This issue primarily occurred with the pronunciation of some regular past tense (or past participle) verbs, such as "attacked," which was pronounced as [ætæked]. This type of error reflects spelling pronunciation of words, as discussed by Keshavarz (2015).

Table 2.

Frequency and percentage of the participants mispronouncing VCC#

Type of VCC#	Frequency of mispronouncing participants	Percentage of mispronouncing participants
V-nasal-stop#	0	0%
V-lateral-stop#	4	10%
V-lateral-nasal#	0	0%
V-fricative-stop#	5	12.5%
V- stop- s/z#	0	0%
V-stop-stop#	11	27.5%

In pronouncing coda clusters, learners faced difficulties with the VCCCC# feature, which does not exist in Iraqi Arabic (IA) or Classical Arabic. As shown in Table 3, 85% of the participants employed a straightforward strategy to address this issue by deleting the final consonant in the cluster. For example, with the word /teksts/, learners omitted the last consonant, pronouncing it as [tekst].

Table 3.

Frequency and percentage of the participants mispronouncing VCCC# and VCCCC#

Type of coda cluster	Frequency of mispronouncing participants by deleting the last consonant	Percentage of mispronouncing participants
VCCC#	4	10%
VCCCC#	34	85%

Our findings align with the studies of Eckman (1991), Carlisle (1997, 1998), and Eckman and Iverson (1994), which explored how learners address non-existent features in onset and coda clusters. These studies investigated consonant clusters in onsets or coda positions where the learners' native language (NL) had fewer or less marked clusters compared to the target language (TL). Eckman (2008) updated his Structural Conformity Hypothesis (SCH) to account for situations where learners' interlanguage grammars permit the production of more complex clusters than in their NL, yet these structures remain less complex compared to those in the TL (in this case, English).

Additionally, the study found that heterosyllabic obstruent-obstruent clusters in multisyllabic words posed no difficulty for Iraqi English learners. The participants demonstrated a strong command of this pronunciation rule, showing no errors in words containing such structures.

In order to examine whether there is a unified constraint ranking for pronunciation errors in each category, we conducted an analysis using Optimality Theory (OT). Among gathered data from the error pronunciation of Iraqi participants, some errors were related to the difficulty in pronunciation of consonant clusters in onset and coda position. In this section these errors were analyzed based on optimality theory.

4-1. Onset Clusters

According to Ghalib (1984), the syllabic structure of Iraqi Arabic in onset position includes #CV and #CCV. Therefore, it is anticipated that participants would not struggle with pronouncing initial clusters in English. However, the data shows that some participants did face difficulties and tended to break the clusters by inserting a vowel through epenthesis or prosthesis.

According to Table 1, only 15% of the participants had difficulty pronouncing #fricative or plosive + liquid clusters. This could be because, in Iraqi Arabic, most words with initial consonant clusters follow this pattern (e.g., /flus/ "money", /trab/ "sand"). Consequently, those who pronounced these clusters correctly likely transferred this feature from their first language to English. On the other hand, learners who mispronounced these clusters may have simplified them by inserting a vowel, as #CCV is more marked than #CV.

Based on Tableau 1, which shows the optimality analysis of /treɪ/ and /flaɪ/ as two instances of fricative/plosive + liquid clusters, participants over-ranked the markedness constraint *COMPLEX onset due to the strategy of simplification, causing the candidates [treɪ] and [flaɪ] to lose the competition. The candidates [ɪtreɪ] and [ɪflaɪ] were also discarded since they violated Anchor-L which states that any element at the left edge of a morpheme in the input must have an identical correspondent at the left edge of the output (Orie & Pulleyblank, 2002). Ultimately, the optimal candidates [tɪreɪ] and [fɪlaɪ] won the competition by violating the lowest ranked constraint, DEP-V, which indicates that every vowel in the output must have a correspondent in the input (Orgun, 2001),. The ranking of constraints is as mentioned in (1). According to this ranking, since there is no conflict between *COMPLEX onset and Anchor-L, a comma is inserted between them in the ranking and the vertical line in the tableau is dashed. DEP-V is ranked lowest since there is a conflict between this constraint and the other high-ranked ones. If DEP-V were higher than Anchor-L or *COMPLEX onset, then the candidates b and a respectively would become winners. So in order for candidate c to become the winner, DEP-V should be ranked the lowest.

1) Ranking of constraints: *COMPLEX onset, Anchor-L >>DEP-V

Tableau 1.

Epenthesis for breaking the cluster of #fricative or plosive + liquid

Input: /treɪ/, /flaɪ/	*COMPLEX onset	Anchor-L	DEP-V
a. [treɪ], [flaɪ]	*!		
b. [ɪtreɪ], [ɪflaɪ]		*!	*
c. ☞ [tɪreɪ], [fɪlaɪ]			*

For syllables starting with #/s/ + voiceless stop, 75% of Iraqi learners experienced pronunciation difficulties. Among them, 83.3% (n=25) tended to insert a vowel in the middle to break the cluster, while only 16.7% (n=5) inserted a vowel at the beginning of the cluster. The optimality analysis of both strategies is presented in Tableaus 2 and 3 for the word "skill." Due to the participants' tendency to break the cluster, the markedness constraint *COMPLEX onset is over-ranked compared in both tableaux to other constraints. Since the candidate [sıkıl], in tableau (2) is the optimal one, DEP-V/S_T is the lowest in the ranking. This constraint assigns a violation mark for every vowel in the output that follows a sibilant and precedes a stop and does not have a correspondent in the input (Zuraw, 2007). Anchor-L is the other constraint which is over ranked DEP-V/S_T but its rank is lower than *COMPLEX^{onset} because if Anchor-L were ranked higher than *COMPLEX^{onset}, in tableau (3), the candidate [ıskıl] would be kicked out of the competition and would not be the optimal candidate.

2) *COMPLEX ^{onset}>> Anchor-L >> DEP-V/S_T

Tableau 2.

Epenthesis for breaking the cluster of #/s/ + voiceless stop

Input: /skıl/	*COMPLEX onset	Anchor-L	DEP-V/S_T
a. [skıl]	*!		
b. [ıskıl]		*!	
c. ☞ [sıkıl]			*

Based on Tableau 2, the optimal candidate [sıkıl] only violated the lowest ranked constraint, DEP-V. The candidate [skıl] had a fatal violations of *COMPLEX onset. Anchor-L was ranked higher than DEP-V/S_T to ensure the preference for epenthesis of a vowel over prothesis.

3) *COMPLEX onset >> DEP-V/S_T >> Anchor-L

Tableau 3.

Prothesis for breaking the cluster #/s/ + voiceless stop

Input: /skıl/	*COMPLEX onset	DEP-V/S_T	Anchor-L
a. [skıl]	*!		
b. [sıkıl]		*!	
c. ☞ [ıskıl]			*

As indicated in Tableau 3, [ıskıl] can be the optimal candidate only if

Anchor-L is ranked lowest and DEP-V/S-T is ranked higher to ensure that prosthesis of a vowel wins over epenthesis.

For the case of /s/ + nasals and liquids, only 25% of the participants had pronunciation problems, and nearly all of them inserted a vowel at the beginning of the cluster to break it. Based on optimality analysis, the markedness constraint of *COMPLEX onset, the faithfulness constraints DEP-V/S_m and DEP-V/S_l were ranked higher than DEP-V. Since there is no conflict between *COMPLEX onset and DEP-V/S_m and DEP-V/S_l, they have the same rank. This ranking ensures that prosthesis wins over epenthesis in pronouncing clusters of #/s/ + liquid or nasal. DEP-V/S_m assigns a violation mark for every vowel in the output that follows a sibilant and precedes an [m] and does not have a correspondent in the input, and DEP-V/S_l assigns a violation mark for every vowel in the output that follows a sibilant and precedes an [l] and does not have a correspondent in the input (Zuraw, 2007).

4) Ranking of constraints: *COMPLEX onset, DEP-V/S_m, DEP-V/S_l >>DEP-V

Tableau 4.

Prosthesis for breaking the cluster of #/s/ + liquid or nasal

Input: /sli:p/, /sneɪk/	*COMPLEX onset	DEP-V/S_m/ DEP-V/S_l	DEP-V
a. [sli:p], [sneɪk]	*!		
b. [sɪli:p], [sɪneɪk]		*!	
c. ☞ [ɪsli:p], [ɪsneɪk]			*

As mentioned in Tableau 4, candidate (b) demonstrating epenthesis of the vowel lost the competition because it violated DEP-V/S_m and DEP-V/S_l.

According to Yavaş (2011), the error patterns of Egyptian Arabic speakers show that clusters violating sonority sequencing are modified using vowel prosthesis, while clusters that do not violate this sequencing receive an epenthetic vowel, resulting in a speedier and more native-like pattern. This pattern differs from that of Iraqi Arabic speakers. In Iraqi Arabic, the epenthetic strategy is employed in cases of violating sonority sequence (Tableau 3), while for non-violating sonority sequences, two strategies are used depending on the type of cluster: prosthesis for #/s/ + nasal or liquid (Tableau 4) and epenthesis for #fricative or plosive + liquid (Tableau 10).

The cluster of three consonants in the initial position is absent in Iraqi Arabic. According to the data, all participants had difficulty pronouncing clusters of three consonants and modified them by inserting vowels. Two vowels were inserted after the first and second consonants to break the cluster into three syllables. Since #CCC does not exist in Iraqi Arabic, learners tended to transfer this feature to the target language. Consequently, the markedness constraint *#CCC ranked higher in the optimality analysis. This constraint prohibits the occurrence of three consonants in the initial position. Additionally, the structure of #CCC in English is limited to #/s/ + voiceless stop + liquid or glide (Roach, 2009). *#CCC and Anchor-L have the same rank because there is no conflict between them. Anchor-L ranked higher than DEP-V to ensure that epenthesis wins over prosthesis in breaking the cluster of #CCC. Tableau 5 indicated this analysis for the word "structure."

5) *#CCC >> Anchor-L >> DEP-V

Tableau 5.

Epenthesis for breaking the cluster of #CCC

Input: /strʌk.tʃər/	*#CCC	Anchor-L	DEP-V
a. [strʌk.tʃər]	*!		
b. [ɪs.tɪ.rʌk.tʃər]		*!	**
c. ☞[sɪ.tɪ.rʌk.tʃər]			**

4-2. Coda Clusters

The syllabic structure of Iraqi Arabic in coda position is VCC# (Ghalib, 1984). Therefore, it is expected that Iraqi learners of English would not encounter problems pronouncing coda clusters. However, as shown in Table 2, learners experienced difficulties with coda clusters in some regular past tense (or past participle) verbs, pronouncing words based on their spelling. For example, they pronounced "based" as [beɪsed], "killed" as [killed], and "attacked" as [ætæked]. According to Keshavarz (2015), this type of error is known as spelling pronunciation. Although the constraint *CCcoda (which prohibits clusters of two consonants in the coda position) is not violated in Iraqi Arabic, it is violated in Classical Arabic. Since learners transfer this feature to English, this constraint is ranked low in the optimality analysis. To lose the competition, a candidate must violate a high-ranked constraint, which in this case is not *CCcoda but rather an orthographic constraint, SIMPLICITY. The reason *CCcoda is not violated by Iraqi learners and is ranked lower than SIMPLICITY is that learners pronounce coda clusters differently in various words. For example, they pronounce "fact" correctly but "attacked" incorrectly. This indicates that *CCcoda cannot be the reason for the pronunciation error. SIMPLICITY, which ensures a one-to-one mapping between sounds and letters (Coulmas, 1989), is ranked higher in analyzing errors related to spelling pronunciation. DEP-IO is ranked lowest because if its ranking were higher than $*CC^{coda}$, candidate b would win the competition and candidate c would not be optimal. Tableau 6 demonstrates the optimality analysis of "attacked," which was pronounced erroneously as [ætæked].

6) SIMPLICITY>> $*CC^{coda}$>> DEP-IO

Tableau 6.

Spelling pronunciation of words

Input: /ə.tækt/	SIMPLICITY	$*CC^{coda}$	DEP-IO
a. [ə.tækt]	**	*	
b. [ə.tækd]	*	*	
c. ☞ [ataked]			*

Based on Tableau (6), SIMPLICITY had the highest rank, so candidate (a) violated this constraint twice. Also, candidate (b) was eliminated from consideration for violating SIMPLICITY and $*CC^{coda}$. Consequently, candidate (c) emerged as the winner since it only violated the lowest ranked constraint, DEP-IO.

Although VCCC# is not present in Iraqi or Classic Arabic, the results show that participants did not encounter significant problems with pronouncing this cluster. Table 3 illustrates that only 10% of the participants adjusted the difficulty of pronouncing the three-consonant cluster by omitting the final consonant. For words ending in four-consonant clusters, 85% of participants chose to delete the last consonant in the cluster.

In the optimality analysis for this case, the constraints *CCCcoda (prohibiting clusters of three consonants in the coda position) and *CCCCcoda (prohibiting clusters of four consonants in the coda position) are ranked higher in the hierarchy. Conversely, the constraint MAX-IO is ranked lowest since it does not favor the optimal candidate. Tableau (7) provides the details of this analysis for the word "texts".

7) $*CCCC^{coda}$ >> MAX-IO

Tableau 7.

Deletion of the last consonant in VCCCC#

Input: /teksts/	$*CCCC^{coda}$	MAX-IO
a. [teksts]	*!	
b. ☞ [tekst]		*

Based on the data collected, all participants had no difficulty pronouncing heterosyllabic obstruent-obstruent clusters in multisyllabic words, such as “September,” “catbird,” “picture,” “October,” and “dictionary.” The focus was on the pronunciation of the underlined sounds in these examples. This is because both English and Iraqi Arabic syllables permit obstruent clusters at syllable boundaries. This finding contrasts with Yeh (2022), which claimed that Mandarin syllables strictly prohibit complex syllable margins, leading learners to use either epenthesis or segment deletion to address the pronunciation of English words with complex syllable margins.

As previously discussed, by analyzing constraint rankings, we assessed the strategies and simplification techniques employed by Iraqi EFL learners when pronouncing various consonant clusters in onset and coda positions, and investigated the transfer processes causing interference between the two languages. We explored the different categories of mispronunciations among Iraqi EFL learners to determine if they are significantly impacted by the permutation of constraint rankings from Iraqi Arabic to English.

When pronouncing initial clusters of two consonants, the high-ranked constraints *COMPLEX ONSET and SON SEQ are often violated in Iraqi Arabic (IA), as many words in IA begin with #CCV. Therefore, the ranking of these constraints from IA is not permuted. However, when participants pronounce words with initial clusters of three consonants, *#CCC is never violated in IA. As long as this constraint is low-ranked in English, its rank order is changed in IA, so that learners apply this constraint to simplify the cluster.

When final clusters of two consonants are pronounced, although *CCcoda is never violated in Iraqi Arabic (IA), this constraint is not permuted in the utterance of English learners of IA. The mispronunciations of words with the structure VCC# were attributed to spelling pronunciation. The two low-ranked constraints of *CCCCcoda and *CCCcoda in English are permuted to high-ranked constraints in the pronunciation of English learners of IA.

5. Conclusion

The current study aimed to investigate the pronunciation difficulties faced by Iraqi EFL learners with non-Arabic sounds. To achieve this, 40 first-year university students (20 male and 20 female) aged 18-25, selected from beginner and lower-intermediate levels based on their OPT scores, participated in the study. Utilizing instruments, such as reading instruction and read-aloud tests, and referring to the major pronunciation problems identified by Yavaş (2011), the research employed optimality-based quantitative analysis with descriptive statistics.

Throughout the study, numerous examples were observed where participants addressed clusters by inserting a vowel, either through epenthesis or prosthesis. It was concluded that features aligning with the Arabic sound system were easily transferred to the target language structure. However, structures highly ranked according to optimality theory remained challenging for learners. For example, since the Arabic sound system does not support the optimality ranking, and *CCCCcoda is ranked highest in IA due to the marked nature of VCCCC#, the ranking order of this constraint is changed. Mismatches between the two languages may also stem from teachers and trainers who may not effectively help learners distinguish and integrate the sounds of the foreign language into its phonological system. Increased training on problematic sounds can improve students' ability to make accurate inferences about the English sound system and reduce errors.

OT contributes to the analysis of the learning/ teaching process by providing insights into how learners build their constraint rankings, taking into account both universal principles and language-specific input. OT can help explain the phonological errors learners make by identifying how learners' rankings of universal constraints differ from those of the target language. Since learners are often influenced by the constraint rankings of their native language, this can result in predictable phonological errors. For example, learners might simplify complex consonant clusters or fail to distinguish between sounds that are distinct in the target language but not in their native language. OT provides a framework to predict and analyze these errors by comparing the constraint rankings in the learner's interlanguage with those in the target language (Broselow et al., 1998).

OT can inform pronunciation teaching by highlighting which constraint violations are likely to be more challenging for learners. Teachers can focus on constraint rankings that learners tend to mis-rank, helping them prioritize certain phonological structures in their teaching. For example, by understanding that a markedness constraint (such as avoiding consonant clusters) may be ranked higher in a learner's native language, teachers can create targeted exercises to practice consonant clusters, thus guiding the learner to adopt the correct ranking in the target language (Archibald, 2005).

Certain macro-policies impose intervening factors that create inconsistencies and deficiencies in teaching English as a foreign language. These problems often affect both students and teachers, who are compelled to follow certain guidelines. For instance, professors might be required to teach and present materials in Arabic using inappropriate teaching methods and poorly translated sources. This can lead to a situation where English instruction is reduced to preparing students for tests through multiple-choice items, rather than fostering genuine language learning. Ideally, learners should not view

English merely as a means to pass a test and obtain a language certificate. Instead, they should engage with the language as a voluntary and intrinsic part of their education, applying their knowledge in various contexts during and after their studies.

Different strategies to enhance students' listening abilities should be emphasized. Given that some learners who experienced various target language contexts were able to differentiate between problematic sounds, these findings should be highlighted and incorporated into ELT programs. Introducing the latest technologies and materials can also significantly improve pronunciation skills and help learners distinguish problematic sounds more effectively.

Finally, the critical role of teachers in enhancing students' communicative competencies and pronunciation abilities must be recognized. Teachers can leverage a variety of tasks and activities to increase students' awareness of the target language's components and familiarize them with its phonological system. Some errors can be addressed by teaching students rules for making inferences based on their learning and following specific directions. Additionally, incorporating useful ELT materials, sources, games, and applications tailored to students' needs and interests can be effective methods for instruction. Teachers should seize every opportunity to bridge the gaps between languages and improve pronunciation.

Further research is needed to strengthen the findings of this study and to determine whether they are replicable in different settings with unique characteristics. Firstly, comprehensive studies should investigate the mispronunciations of a broader range of Arab students to produce more detailed, generalizable findings. Secondly, research should explore other categories of learners' errors that were not addressed in the current study. Thirdly, intervention studies using control groups could examine factors such as the impact of textbooks, students' exposure to the target language context, teacher expertise and instructional methods, the use of media and realia in classrooms, and even the literacy levels of students' families. Finally, since learners' mispronunciations are influenced by their teachers, it is important to investigate how effective teachers contribute to establishing proper pronunciation guidelines and enhancing their students' pronunciation skills.

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