

Metathesis in Najdi Arabic: An Optimality Theoretic Analysis

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Abstract

Metathesis is a phonological phenomenon involving the reordering of segments within words. Despite its presence in Arabic dialects, it has received limited scholarly attention, particularly within Saudi varieties. Furthermore, this phenomenon has not been systematically investigated in these varieties within the framework of Optimality Theory (OT). The current study presents a systematic analysis of consonant, long vowels, and VVC metathesis in Najdi Arabic (NA), a dialect spoken in central Saudi Arabia within the OT framework. It examines the extent to which phonetic, phonological, and morphological factors influence metathesis in NA and demonstrates how OT effectively accounts for the reordered patterns. Data were gathered from publicly available social media posts by NA speakers and from my collection of metathesized words, compiled as a native NA speaker from other native NA speakers. The analysis reveals that metathesis in NA is highly motivated by phonological conditions, particularly the Syllable Contact Law and the Sonority Sequencing Principle, as well as phonetic factors, such as the tendency to pronounce articulatory effortful sounds earlier in the sequence. The primary constraints identified are MAX-IO, SCL-STOP, *LATE-STRONG, SSP, and LINEARITY. Besides, it occurs in trilateral roots in verbs, while it happens in trilateral and quartiles in nouns. The findings show that metathesis in NA is shaped by the interaction among variant linguistic domains rather than by a single actor. The study concludes by proposing future experimental investigations into native NA speakers' perception and production of different types of metathesis in NA.

Keywords: Metathesis; Najdi Arabic; Optimality Theory.

INTRODUCTION

Metathesis is a phonological phenomenon observed across many languages that was noticed earlier, such as Lithuanian (Hume, 2004), Judeo-Spanish (Bradley, 2007), and Classical Arabic (Jinny & Hindawi, 2008). It refers to the reordering of adjacent and non-adjacent sounds within words (Blevins and Garrett, 1998). However, it is less documented in the literature compared to other phonological phenomena, such as assimilation or epenthesis (Davenport & Hannahs, 2013). Its occurrence provides significant insights into the nature of phonological systems in languages (Hume et al., 2001). Metathesis can range from segmental reordering in specific words to patterns influenced by phonetic, phonological, or morphological factors. For instance, in Scottish English, a V1C2C3 sequence is reordered to C2V1C3 influenced by a phonological condition that prohibits having sonorants as a coda cluster, as in the word “/patəɪn/ ‘pattern’ → [patɪən]” (Davenport & Hannahs, 2013. p. 206).

According to Jinny and Hindawi (2008), metathesis in Arabic aligns with the principle of ease of articulation that cares about humans' pronunciation habits to produce words with the easiest and least effort, where specific sounds are reordered to reduce articulatory effort. There are three primary factors influence this phenomenon: (1) closeness in place of articulation, (2) similarity in manner of articulation, and (3) the prioritization of sounds requiring greater articulatory effort, such as stops, over others. An example of metathesis in Arabic is the reordering in “/dʒaʔ/ ‘he came’ → [ʔadʒa]” (Naser, 2023, p. 587) where there is [a] epenthesis at the end of the word. Despite its presence in Arabic, metathesis has received limited attention in research, particularly in regional dialects such as Najdi Arabic (NA), spoken in central Saudi Arabia. The current study seeks to address this gap by analyzing metathesis in NA within the framework of Optimality Theory (OT). By identifying the phonetic, phonological, and morphological factors that lead to segmental reordering in NA, this study aims to enhance our understanding of its phonological system. In doing so, it contributes to the broader field of Arabic phonological and phonetic research by exploring this understudied phonological phenomenon.

Najdi Arabic (NA) is one of the main dialects spoken in Najd province, which is in the central area of Saudi Arabia that covers about fourth of the Saudi Arabia's land. It encompasses Riyadh region, Qassim and Hail (AlOboudi, 2015). However, NA, in this study, refers to the spoken dialect in and around Riyadh, since it is the main area and the center of Najd province. NA has numerous phonetic and phonological features that distinguish it from other Arabic dialects. According to Ingham (1994), NA has eight vowels. It has three short vowels: /a/, /i/, and /u/, while it has five long vowels: /i:/, /a:/, /u:/, /e:/, and /o:/. The vowel system of NA is larger than the system of Modern Standard Arabic (MSA) since MSA has only six vowels: three short vowels, /a/, /i/, and /u/, and three long vowels, /i:/, /a:/, and /u:/ (Kalaldeh, 2018). The diphthongs /aj/ and /aw/ in MSA are realized in NA as /e:/ and /o:/ (Ingham, 1994). Additionally, NA has a phonemic inventory similar to MSA but with a few differences in some sounds, as the addition of the velar stop /g/ (AlAmro, 2015).

Table 1. The Phonemes of NA

	Stop	Affricate	Fricative	Tap	Lateral	Glide	Nasal
Bilabial	b					w	m
Labiodental			f				
Dental	t ^ɕ		θ	ð			
			ð ^ɕ				
Alveolar	t d ts (d ^ɕ)		s z s ^ɕ	r	l		n
Alveo- palatal		dʒ	ʃ				
Palatal						j	
Velar	k g						
Uvular	q		χ ʁ				
Pharyngeal			ħ ʕ				
Glottal	ʔ		h				

Source: The Consonantal Inventory of Najdi Arabic (Alghamiz, 2013)

AlAmro (2015) presented three syllable structures in NA: light, heavy, and superheavy. Light syllables CV occur in any position in words, such as [ja.na.mu:n] ‘they sleep’. Heavy syllables like CVV usually occur medially or initially, while CVC and CCV syllables can occur in any position in words. For instance, [ma.na.məh] ‘his sleeping

mattress'. Superheavy syllables can be CVVC or CVCC, like [ki.ta:b] 'book' where they occur in final position only. However, affixes influence words' syllabification based on the number of syllables in the root word (Alrasheedi, 2023). For example, /no:m/ 'sleeping' with a singular masculine suffix becomes: /no:.mah/ 'his sleeping'.

Optimality Theory, introduced by Prince and Smolensky (1993), is one of the fundamental theoretical frameworks in phonology. It illustrates how the phonological systems of languages fit together. The output forms occur based on the universal ranked constraints. These constraints are divided into two categories: markedness and faithfulness constraints (Breiss & Hayes, 2020). Markedness constraints prohibit or require particular structures in the output form. They present how languages are different in linguistic structures. In contrast, faithfulness constraints prohibit changes between the surface form and the underlying representations (McCarthy, 2008).

OT is a flexible theoretical framework applied to multiple phonological processes, such as emphasis spread (Abalkheel & Al Toreegi, 2025), semisyllable in coda clusters (Alhammad, 2019), syllabification patterns, consonant clusters, and stress placement (Alshammari, 2023), and onset clusters (Ruthan, 2024). Its power lies in applying universal constraints to provide a framework that presents the similarities and differences in the phonological systems across languages (McCarthy, 2008).

Metathesis, reversing segments within words, is a phonological process analyzed in many languages, such as Latin, French and Spanish (Strazny, 2005). Despite its presence in Arabic, metathesis remains underexplored, particularly in relation to phonetic, phonological, and morphological principles. Although some studies have examined metathesis in Arabic dialects (e.g., Habib, 2022; Idrissi, 2023; Alnuqaydan, 2025), they have largely overlooked different metathesis types. Moreover, research applying OT to metathesis in Arabic remains notably limited. This lack of studies leaves a critical need in understanding segment reordering within the Arabic phonological system, including NA. Consequently, this research seeks to fill this gap by applying the OT framework to analyze types of metathesis in NA. Specifically, the study focuses on exploring the role of phonetic, phonological, and morphological factors in shaping metathesis patterns and develops a phonological and phonetic constraint hierarchy that explains these patterns within OT.

Metathesis occurs between adjacent segments in CC, CV, and VV sequences, as in /gud-nonni/ 'they finished' becomes [gundonni] in Sidamo, an Ethiopian language (Hume, 2004, p. 208), as well as between non-adjacent sounds, as in /zandʒabi:l/ 'ginger' pronounced as [dʒanzabi:l] in Iraqi Arabic (Jasim & Sharhan, 2013, p. 13). Typically, metathesis results in pronunciation patterns that are easier to articulate than the original forms of words (Hume, 2004). Buckley (2011) argued that metathesis occurs not only within stems but also with morphemes. For example, in Tiberian Hebrew, the word /hit-pa'el/ 'he prayed' undergoes metathesis, where the /t/ sound is reversed with the initial stop, resulting in the pronunciation [hipta'el] (Buckley, 2011, p. 4).

Additionally, Hume (2004) proposed that two conditions must be met for metathesis to occur. First, the output pattern resulting from metathesis must exist in the language. Second, there must be indeterminacy within the signal, meaning that listeners are familiar with the language's sounds, sound patterns, and morphemes. Furthermore, listeners must recognize the phonetic cues and the context in which the metathesized words are presented. Edwards (2018) analyzed metathesis in the Amarasi language, an Austronesian language of western Timor, revealing that it often co-occurs with other

phonological processes, such as consonant and vowel deletion and vowel assimilation. Metathesis in Amarasi serves two primary functions: syntactic and discourse functions. Syntactically, metathesis distinguishes between sentences and phrases. For example, “[**fat**o koʔu] means ‘stones are big’ while [**fa**ot koʔu] means ‘(a) big stone’” (Edwards, 2018, p. 38). Consequently, metathesis in some languages leads to different linguistic functions depending on the order of sounds.

Modu (2024) investigated the causes of metathesis in English, particularly Standard British English. He argued that metathesis arises due to borrowing from other languages, such as Arabic, French, and Latin. Additionally, the historical development of English has influenced sound order, as seen in the transformation of Old English *hros* to Modern English *horse*. Borrowed words that do not conform to English phonological rules may also undergo reordering to align with these rules. In addition, speech context can influence sound order, as children often alter sounds and their order. Finally, dialectal differences, such as those between American and British English, can lead to metathesis. There are multiple reasons that explain metathesis occurrence in language that might be historical or due to borrowing.

Jasim and Sharhan (2013) analyzed metathesis in Iraqi Arabic. They demonstrated that metathesis is a phonological phenomenon in Iraqi Arabic occurring between both adjacent and non-adjacent segments. Notably, metathesis can involve three sounds, not just two, with non-adjacent segments being the most frequently reordered. Additionally, metathesis in Iraqi Arabic occurs predominately at the root level of words and does not involve morphemes, unlike Tiberian Hebrew (Buckley, 2011). Consonants, particularly liquids and the stop /t/, are more likely to undergo metathesis than vowels. Jasim and Sharhan concluded that metathesis in Iraqi Arabic is not a systematic phenomenon. Consequently, metathesis is not always systematic, mainly when it occurs in a limited number of words in a language.

Gutiérrez (2020) analyzed VC metathesis and the effect of affixes within an Optimality Theory (OT) framework in Nivaʿle, a Mataguan language. The researcher argued that metathesis occurs under two conditions: (1) the absence of complex codas and (2) adherence to the SCL, which requires that the first segment of the second syllable be less sonorous than the last segment of the preceding syllable. In Nivaʿle, the final syllable VC in the stem is reversed to CV when a suffix is added, which contrasts with Iraqi Arabic (Jasim and Sharhan, 2013). This metathesis serves to avoid complex codas resulting from suffixation. Gutiérrez employed several constraints in his analysis: LINEARITY-IO, which rejects metathetic forms, and CC]σ, which mandates simple codas. Additionally, he introduced the constraint SCL*[-son]]σ σ[[+son]) to account for the SCL as well as a constraint ensuring simple onsets *[σ CC, alongside two faithfulness constraints: MAX-SEG and DEP-IO-V.

Alqahtani (2018) analyzed metathesis in Modern Persian within the OT framework. Focusing on the phonological derivations of metathetic forms. In Modern Persian, metathesis is conditioned by the SSP and the SCL. Metathesis occurs in word-final consonant clusters, particularly when the first C in the coda is less sonorous than the second. This reordering ensures compliance with the SSP and prevents vowel epenthesis between the consonant clusters. To account for metathesis in Modern Persian, Alqahtani utilized the following constraint hierarchy: ONS>>*COMLEX_{ONS}>>MAX-IO>>DEP-IO>>SSP>>SYLLCONTT>>LINEARITY>>*COMLEX_{COD}.

AllahweisiAzar and Nejad (2018) investigated metathesis in Kalhori, a variety of Kurdish, using OT. They found that metathesis occurs more frequently in loanwords than in native Kalhori words. In this variety, metathesis functions as a repair strategy to comply with the SSP and SCL, similar to Modern Persian (Alqahtani, 2018). The researchers applied distinct constraints depending on the type of metathesis. For consonant cluster reversal, they used *REVERSAL(SSP) >> LINEARITY. When metathesis involves the coda of the first syllable and the onset of the second syllable, the constraints SYLLCONTT >> MAX >> LINEARITY were applied. Finally, for metathesis within a single syllable (onset and coda), the constraints were employed: SYLLCONTT>>MAXIMALITY>> LINEARITY>> IDENTITY(γ F). This non-contiguous type of metathesis was found to be less systematic and less common than the other types. However, the researchers used different constraints for every metathesis type.

Idrissi (2023) analyzed metathesis in Moroccan Arabic within the OT framework, focusing on the reordering of consonant sequences, as in /zəʃma/ ‘really’ pronounced as [zəmfə] (Idrissi, 2023, p. 63). The researcher argued that metathesis in Moroccan Arabic occurs to adjust structures to comply with the SCL. Four constraints were proposed to account for CC metathesis: LINEARITY-IO, which penalizes deviations from the input order; SYLLCONTT, which enforces the SCL; DEP-IO, which accounts for schwa epenthesis to avoid three-consonant clusters; and COMPLEX, which prohibits complex consonant clusters. The constraint ranking was established as: COMPLEX, SYLLCONTT >> LINEARITY-IO, DEP-IO.

In contrast, Habib (2022) examined metathesis in Syrian Arabic within the OT framework, identifying two types of metathesis: phonologically conditioned and morpho-phonologically conditioned metathesis. Phonologically conditioned metathesis occurs between adjacent root consonants, with /z/ being the only consonant that reorders with a non-adjacent segment. This reordering involves liquids, postalveolars, pharyngeals, and the fricatives /z, s/, and it is not systematic. In contrast, morpho-phonological conditioning metathesis occurs in words derived from the Standard Arabic reflexive verb pattern, /(?i)ftaʃal/. Here, the reflexive /t/ is reordered with the first consonant of the root. For example, “/rtaʃa:/ ‘he relaxed’ becomes /traʃʃa:/” (Habib, 2022, p. 19). Habib accounted for this behavior using the following constraints: LINEARITY, INTEGRITY, *CODA, IDENT(STRESS) >> WEIGHT-BY-POSITION, LEFT-ANCHOR(T).

Alqahtani (2014) studied CV metathesis in NA within the OT framework, exploring its impact on syllable structure and its relationship with vowel epenthesis and deletion. He argued that onset consonant clusters in NA result from metathesis, as in the example: “/naʃ.lah/ ‘palm tree’ → [nʃa.lah]” (Alqahtani, 2014, p. 166). The constraints used in his analysis included ONS, LINEARITY, MAX-IO, MAX- μ -IO, *COMPLEXONS, DEP-IO, *COMPLEXCODA, *CODA, and SYLLCONTT. Additionally, he introduced *LLL to prohibit sequences of three light syllables and *LENITION-GUTTURAL to prevent the lenition of guttural sounds into more sonorant, vowel-like segments. According to his analysis, metathesis in NA is motivated by avoiding rising sonority across syllable boundaries. However, SCL and SSP are not always complied with in NA. They are found to be violated, like in the sequence /nʃ-/.

In contrast, Alshahrani (2022) provided a different view of the reordering of gutturals and the low vowel /a/. According to his analysis, guttural metathesis refers to reversing guttural that is followed by a consonant with a preceding low vowel /a/ VGC to be GVC, as in “/taʃrab/ ‘ruin’ → [t.ʃa.rab]” (Alshahrani, 2022, p. 111). Metathesis is

a result of two-stage process called pseudometathesis: [a] epenthesis and deletion which results in CV metathesis. First, [a] addition happens after the guttural sound to be a trisyllabic word [ta.χa.rab]. Then, the deletion of the first [a] happens to be [t.χa.rab] which ends up with CV metathesis. The applied constraints were: *aGC constraint that prohibits having [a] followed by a guttural consonant. LINEARITY and *LL that prevents having two light syllables in a word. Thus, this two-stage process is limited to gutturals followed by a consonant and the low vowel /a/.

Alnuqaydan (2025) analyzed metathesis in Qasimi Arabic verbs with vowel initial suffixes produced by elders. He argues that metathesis is related to stress placement in the structure /'C₁V₂C₃.C₄V₅.C₆V₇C₈/ to optionally be [C₁V₂. 'C₃ V₅C₄.C₆V₇C₈], like in the word “/jatbəʃ+uh/ ‘he follows him’. It has two orders; [‘jat.bə.ʃuh] and the metathesized shape [ja.‘təb.ʃuh]” (Alnuqaydan, 2025, p. 644). In this example, metathesis is motivated to satisfy stress placement in the penultimate heavy syllable in Qasimi Arabic. In the original order [‘jat.bə.ʃuh] stress did not fall on the penultimate because it is a light syllable, but when speakers make the stress on the penultimate, they need VC metathesis. His constraints focused on stress placement and weight, like ALIGN(‘σμμ R, wd, R) and the metathesis constraint LINEARITY. In summary, Idrissi (2023), Alqahtani (2014), Alshahrani (2022), and Alnuqaydan (2025) systematically analyzed metathesis within the OT framework in Moroccan Arabic, NA, and Qasimi Arabic, respectively. They focused exclusively on CV metathesis in multisyllabic words, while Habib (2022) argued that metathesis in Syrian Arabic is not systematic unless a morpheme is added to verbs.

The goal of the study is to investigate how phonetic, phonological, and morphological factors influence metathesis patterns in NA. Besides, it aims to develop an OT constraint hierarchy that account for metathesis forms influenced by phonological and phonetic factors. The study proposes that there are phonetic, phonological, and morphological reasons behind metathesized patterns in NA. The study focuses on describing the role of every factor and analyze the phonological and phonetic conditions of metathesis in NA within the OT framework.

This study systematically examines consonant, long vowels, and VVC metathesis in NA, the dialect spoken in and around Riyadh city, by formulating a constraint hierarchy within OT. It seeks to determine the interaction between markedness and faithfulness constraints that drive segments reordering in NA. It aims to answer what phonetic, phonological, and morphological factors influence metathesis in Najdi Arabic, and how do these factors interact to shape its attested patterns? How can metathesis in Najdi Arabic be formally analyzed within the Optimality Theory framework, and what constraint rankings best account for its patterns?

Metathesis in NA holds significance in Arabic linguistics in multiple ways. First, it addresses the shortage of Arabic linguistic studies on metathesis by systematically analyzing NA consonant, long vowels, and VVC metathesis. It enhances our understanding of this less-explored phenomenon in Arabic phonological and phonetic literature. Additionally, it provides insights into the dialectal variation in Arabic by comparing metathesis with other Arabic dialects. This study enhances the application of OT in Arabic phonology by formulating a constraint hierarchy that models metathesis patterns in NA. By identifying and ranking relevant constraints, the study refines OT’s ability to explain segment reordering in Arabic dialects.

METHOD

A corpus of NA tokens was manually extracted from natural publicly accessible social media, written conversations and informal speech produced by NA native speakers (see appendix) since social media environments provide informal and spontaneous use of the dialect. Furthermore, additional tokens were gathered from my observation, as a native NA speaker, of native NA speakers' speech and the participants', native NA speakers, examples of metathesized words they use or hear. This combination of collecting methods makes it suitable for naturally occurrence of phonological processes, especially for a process like metathesis that may not occur in formal speech and allows for more comprehensive representation of it in the dialect. These methods of data collection permit the analysis to reflect authentic usage of patterns in NA, focusing on forms that occur in daily interactions between NA speakers.

The data of the study was collected in two phases. First, I, as a native NA speaker, drawn the data from natural social media conversations produced by NA native speakers, my observation of tokens they use, and the participants' examples of metathesized words. There are criteria that tokens should meet to be included in the data in order to ensure their reliability. The token must be originated by native NA speakers, based on regional and linguistic indicators. Besides, it must present a plausible phonological variant, not a slip of the tongue or orthographic error. Additionally, there must be a clear reordering of segments that are representable of metathesis concept. Finally, it must appear in a meaningful context, where it is understood and might be used by the speaker and receiver. For the second phase, firstly, 4 native Hail Arabic speakers and 7 native Qassimi Arabic speakers were consulted to ensure the existence of the tokens in NA since Hail and Qassim areas are part of Najd province (AlOboudi, 2015). However, these two dialects are not included in the analysis due to dialects' minor differences in pronunciation. After that, fifteen native NA speakers in and around Riyadh, the primary participants of the study, were consulted to evaluate data to determine whether the tokens are used in their area. The participants of the study consisted of 15 native NA speakers, whose ages were between 22 and 60 years old. Riyadh participants were 5 and 10 were from Az Zulfi. There were 5 males and 10 females. The tokens were concurred with the majority of the participants.

RESULTS AND DISCUSSION

Phonological Analysis and Optimality Theory

Metathesis in NA has two types: adjacent and non-adjacent metathesis. Adjacent metathesis is when the coda of the first syllable is reversed with the onset of the second syllable, such as (1a), and in onset clusters, like in (1b). In contrast, non-adjacent metathesis happens between the onset and coda of the same syllable, like (1c). Also, it occurs when sounds are reordered across syllables, as in (1d).

1. /gaʃ.ʃar/ 'he shuddered' → [gaʃ.ʃar].
2. as /ti.-rti.ʃi/ 'she is trembling' → [ti.tri.ʃi].
3. /laχ.batʕ/ 'mixed things up' → [χal.batʕ].
4. /zan.dʒa.bi:l/ 'ginger' → [dʒan.za.bi:l].

The example in (1a) presents that metathesis is conditioned by the SCL where sonority falls across syllables from the guttural /ʃ/ to the fricative [ʃ]. Arabic gutturals /ʕ/ and /ħ/ exhibit sonorant-like acoustic and articulatory properties, thus, they are treated as high sonority segments as approximants, but they do not have a scale in the sonority hierarchy

as other sounds since they are not common in languages (Kenstowics, 1994; McCarthy, 1994; Watson, 2002). Besides, (1b) shows that metathesis can be motivated by the SSP since the most sonorous sound should be the closest to the peak. (1a) and (1b) presents the occurrence of metathesis as a modification strategy for phonological violation of original words. In contrast, Examples in (1c) and (1d) are motivated by phonetic reasons. Additionally, metathesis occurs in three loanwords: /ti.ril.ju:n/ 'trillion' → [ti.lir.ju:n], /kru:.sa:n/ 'croissant' → [kra:.su:n], and /kat.fab/ 'ketchup' → [kaʃ.tab]. These words undergo reordering by native NA speakers to align with the phonological system of sound patterns of NA. The reordered form of the word /kat.fab/ 'ketchup' → [kaʃ.tab] complies with the SCL where sonority falls across syllable.

Based on the previous data from NA, there are five markedness constraints to account for metathesis in NA according to syllables and segments order:

1. ONSET (ONS) — "Syllables must have onsets" (Prince and Smolensky, 1993, p. 17).
2. *COMPLEX_{COD} — "A syllable must not have more than one coda segment." (Prince and Smolensky, 1993, p. 87).
3. SYLLCONTT — "The onset of a syllable must be less sonorous than the last segment in the immediately preceding syllable." (Bat-El, 1996, p. 302).
4. SSP — "Sonority increases towards the syllable peak and decreases towards syllable margins." (Morelli, 2003, p.359).
5. LINEARITY — "No Metathesis. S₁ is consistent with the precedence structure of S₂, and vice versa." (McCarthy and Prince, 1995, p.123).

In order for metathesis to occur, syllables need to start with onsets. Besides, if there is a coda in a syllable, it should not be complex with more than one segment. The SYLLCONTT constraint emphasizes that last sound of a syllable should be more sonorous than the following onset while the SSP requires the sonorous segments to be the closest to the peak. In addition, LINEARITY constraint represents the original order of sounds of words, with no metathesized patterns. Furthermore, there are some faithfulness constraints to be considered in metathesis in NA:

1. MAX-IO — "Every segment of the input has a correspondent in the output. (No phonological deletion.)" (McCarthy and Prince, 1995, p. 16).
2. DEP-IO — "Every segment of the output has a correspondent in the input. (Prohibits phonological epenthesis.)" (McCarthy and Prince, 1995, p.16).

MAX-IO is the constraint that prohibits any deletion of segments in the output whereas DEP-IO prevents addition of segments on the output. Consider the following table where it shows how these constraints interact:

Table 1. Faithfulness Constraints To Be Considered In Metathesis in NA

Input: /gaʃ.ʃar/	MAX-IO	ONS	SYLLCONTT	LINEARITY
	IO			
a) [aʃ.ʃar]	!*	*	*	
b) [gaʃ.ʃar]				*
c) [gaʃ.ʃar]			*!	

Table (1) confirmed the ranking of the constraints. Candidate (1a) is eliminated due to its violation of the MAX-IO and ONS constraints by deleting the onset of the antepenultimate syllable, also, it violates the SYLLCONTT by having a sonority rise

across syllables [aʃ.ʕar]. Similarly, candidate (1c) is eliminated since it violates the SYLLCONT constraint by raising sonority across syllables. Finally, the optimal candidate is (1b) because it satisfies all the high-ranked constraints and only violates the lowest one, LINEARITY constraint.

Consonants Metathesis

Metathesis in NA occurs between adjacent and non-adjacent consonants, as in other Arabic dialects, Iraqi Arabic (Jasim & Sharhan, 2013), Moroccan Arabic (Idrissi, 2023) and Syrian Arabic (Habib, 2022). However, this process is phonologically conditioned by the SCL, where metathesis happens as a phonological repair mechanism to ensure that sounds comply with it. For instance, /ta.ʕak.raʃ/ ‘tripped on’ → [ta.ʕar.kaf]. The order of segments where the stop [k] in coda position followed by the liquid [r] presents raising sonority which violates the SCL since [r] is more sonorous than [k] (Kenstowics, 1994; McCarthy, 1994; Watson, 2002). In contrast, the reordered form [ta.ʕar.kaf] complies with the SCL where sonority falls across syllables.

Similarly, NA complies with the SSP with consonant clusters, prompting the reversing of sounds to maintain following this condition, such as /ti.-rti.ʕiʃ/ ‘she is trembling’ → [ti.tri.ʕiʃ]. The consonant cluster /rt/ in the input /ti.-rti.ʕiʃ/ violates the SSP where the closest segment to the peak is the stop [t] not the liquid [r] which is more sonorous in the sequence than [t]. Thus, reordering the two segments is needed to fill the requirements of the SSP to be [ti.tri.ʕiʃ]. Besides, metathesis occurs with tokens that do not have more than two light syllables, as in /ba.naf.sa.dʒi:/ ‘purple’ → [ba.nas.fa.dʒi:].

1. *LLL — “Assign one violation mark for three light syllables.” (Alqahtani, 2014, p. 170). Consider the following table:

Table 2. Prohibits Phonological Epenthesis

Input: /ti.-rti.ʕiʃ/	*LLL	SSP	LINEARITY
a) [ti.rti.ʕiʃ]		*!	
b) [ti.tri.ʕiʃ]			*
c) [ti.tri.ʕi.ʃ]	*!		*

Candidate (2b) is the optimal output since it respects both constraints, *LLL and SSP while other candidates (2a) and (2c) get fatal violation by violating the phonological conditions for metathesis in NA. (2a) violate the SSP where the stop [t] is the closest to the peak instead of the liquid [r] that is more sonorous while (2c) is excluded since it has three light syllables.

Long Vowel-Consonant Metathesis; metathesis in NA occurs mostly in disyllabic and trisyllabic words with light and heavy syllables, but it rarely happens in superheavy structure CVVC. For example, /ʕa:θ-.biʃ/ ‘he caused chaos on it’ → [ʕa.θa:.biʃ], which is the only attested example of VVC metathesis. This reversal occurs because of multiple reasons. First, there is a vowel epenthesis in order to have a gradual movement of the articulators. The articulation process starts with the pharyngeal [ʕ], short low vowel [a], followed by the dental [θ], and concludes with the long low vowel [a:]. It presents a gradual transformation between the articulators where these movements provide a chance for air release between the sounds, this analysis aligns

with the theory of ease of articulation (Jinny & Hindawi, 2008). Also, there is natural rise and fall sonority in the syllables /ʕa/ and /θa:/.

In contrast, there is a sharp fall in sonority in the word /ʕa:θ-.bih/ ‘he caused chaos on it’ from the back long vowel [a:] to the dental fricative [θ]. Besides, the syllabification of the word has changed into a light open syllable CV [ʕa] and a heavy one CVV [θa:], instead of a one superheavy closed syllable CVVC followed by a heavy syllable [bih], where word /ʕa:θ/ ‘caused chaos’ is usually pronounced with the preposition /bih/ ‘on it’ to be as a one-unit CVVC.CVC. As discussed by Alqahtani (2014), AlAmro (2015), and Alhammad (2019), superheavy syllables in NA should be in final position, which can be violated in some words, as in the previous example. They suggest that superheavy syllables attract vowel epenthesis to change the syllable structure into a lighter one, particularly when superheavy syllables occur medially or initially. Therefore, VVC metathesis is the only type of metathesis in NA that requires an additional phonological process, epenthesis, as a solution for having a superheavy form in initial position and divide it into light and heavy forms CV.CVV.CVC. This rule of superheavy syllables is presented by the following constraint adapted from McCarthy and Prince (1993):

2. ALIGN-RIGHT_(SH, ω) — The right edge of every superheavy syllable must be aligned with the right edge of the prosodic word

Table 3. Problems with Superheavy Syllables

Input: /ʕa:θ-.bih/	MAX-IO	ALIGN- RIGHT _(SH, ω)	DEP-IO	LINEARITY
a) [ʕaθ.bih].	*!			
b) [ʕa.θa:.bih]			*	*
c) [ʕa:θ.bih]		*!		

Output (1a) get a fatal violation due to violating the constraint MAX-IO by deleting the length feature of the vowel [a]. Output (1c) violates the constraint ALIGN-RIGHT_(SH, ω) by having a superheavy syllable in mid-position, which is prohibited in NA. Finally, the optimal output is (1b) since it violates only the least ranked constraints.

Phonetic Analysis: Consonants Metathesis

Multiple phonetic factors influence segments reordering when the segments comply with the MAX-IO, ONS and *LLL. One main phonetic factor is the reordering of plosive sounds and other segments that differ in their manners of articulation. Plosives tend to precede other segments in tokens because of the greater effort required to articulate them (Jinny & Hindawi, 2008), as in (3a) and (3b). Similarly, fricatives, particularly pharyngeals and uvulars, tend to precede other sounds due to their higher articulatory effort (Millar & Trask, 2015), as in (3c) and (3d).

(3) a) /sʕa.ʕi.gəh/ ‘thunderbolt’ → [sʕa.gi.ʕəh]

b) /ja.ʔas/ ‘despaired’ → [ʔa.jas]

c) /ma.ʃiχ/ ‘scratched’ → [ma.χiʃ]

d) /ʔif.ʁasʕ/ ‘squeezed’ → [ʔiʁ.fasʕ]

It can be specified by the following constraint:

3. *LATE-STRONG — Avoid strong / effortful segments late in the word in metathesized segments. The *LATE-STRONG constraint is ranked higher than the SYLLCONTT since the SCL in NA might be violated, as Alqahtani (2014) stated. However, the SCL is obligated if there is a stop sound in the metathesized segments in adjacent metathesis. This point requires the following constraint:

SCL-STOP— Assign a violation for any coda–onset sequence in which the coda is a stop and the sonority across the syllable boundary rises. For example, the word /ta.ʕak.raʕ/ ‘tripped on’ → [ta.ʕar.kaf] complies with the SCL while the word /mil.ʕa.gəh/ ‘spoon’ → [miʕ.la.gəh] follows the *LATE-STRONG phonetic factor.

4. MAX-IO >> ONS >> *COMPLEX_{cod}, *LLL >> ALIGN-RIGHT_(SH,co) >> SCL-STOP >> *LATE-STRONG >> SYLLCONTT >> SSP >> DEP-IO, LINEARITY

Table 4. Problems with Superheavy Syllables

Input: /ta.ʕak.raʕ/	SCL-STOP	*LATE-STRONG	LINEARITY
a) [ta.ʕak.raʕ]	!*		*
b) [ta.ʕar.kaf]		*	*

Candidate (4a) is excluded since it violates the constraint SCL-STOP by having rising sonority between the stop [k] in coda position and the liquid [r]. In contrast, the reordered output satisfies the constraint but violates the *LATE-STRONG. Besides, when there are a sibilant and a stop in the same syllable, the sibilant tends to precede the stop even if it is stronger than the sibilant, like in the word /ʔin.fe.ɡaʃ/ ‘cracked’ → [ʔin.fe.ʃaɡ]. The following constraint account for it:

META_(SIB-STOP) — metathesis is applied to a (sibilant V stop) sequence within the same syllable.

5. MAX-IO >> ONS >> *COMPLEX_{cod}, *LLL >> ALIGN-RIGHT_(SH,co) >> SCL-STOP >> META_(SIB-STOP) >> *LATE-STRONG >> SYLLCONTT >> SSP >> DEP-IO, LINEARITY

Table 5. Problems with Superheavy Syllables

Input: /ʔin.fe.ɡaʃ/	META _(SIB-STOP)	*LATE-STRONG	SYLLCONTT	LINEARITY
a) [ʔin.fe.ɡaʃ]	!*			*
b) [ʔif.ne.ɡaʃ]	!*		*	*
c) [ʔin.fe.ʃaɡ]		*		*

In table (5), candidates (5a) and (5b) are excluded due to their violation of the high ranked constraint META_(SIB-STOP) since reordering of the sibilant [ʃ] and the stop [ɡ] is not applied. Additionally, metathesis can occur when segments share the same place or manner of articulation, as noted by Jinny and Hindawi (2008). For example, the reordering of the fricatives [s] and [f] in /ʕa.saf/ ‘he dropped down’ → [ʕa.fas]. Similarly, reordering the alveolars [r] and [l] in the loan word /ti.ril.ju:n/ ‘trillion’ → [ti.lir.ju:n]. This analysis presents a need for a constraint that prevents sounds with the same place or manner of articulation to have the same order in the output.

HOMORGANIC-LINEARITY— Assign a violation when two segments share the same manner or place of articulation and retain their original linear order. Thus, the order of the constraints will be as follows:

6. MAX-IO >> ONS >> *COMPLEX_{cod}, *LLL >> ALIGN-RIGHT_(SH,co) >> SCL-STOP >> LATE-STRONG >> SYLLCONT >> SSP >> HOMORGANIC-LINEARITY >> DEP-IO, LINEARITY

Table 6. Problems with Superheavy Syllables

Input: /ba.naf.sa.dʒi:/	SYLLCONT	HOMORGANIC-LINEARITY	LINEARITY
a) [ba.fas.na.dʒi:]	*!		*
b) [ba.naf.sa.dʒi:]		*!	
c) [ba.nas.fa.dʒi:]			*

Candidate (6a) is eliminated since there is a sonority rising across the syllables, so it gets a fatal violation. Similarly, the faithful candidate (6b) is excluded since there are two sounds, [f] and [s], from the same manner of articulation in the same position in the output. Finally, the optimal candidate is (6c) since it respects all the high ranked constraints.

Long Vowels Metathesis

Metathesis in NA can happen across long vowels in non-adjacent metathesis, as in /du:.la:b/ ‘cabinet’ → [da:.lu:b]. This reordering follows Hume’s (2004) and Iggab’s (2018) condition, which states that any reordering of sounds can occur if the resulting sound patterns exist within the language. For example, the reordered sequence existed in some NA words, like /da:/ in /da:bb/ ‘sneak’ and the other sequence /lu:b/ in /je-.lu:b/ ‘he works hard’. Words of this type of metathesis have the CVV.CVVC syllable structure. According to Clements (1988), low vowels are the most sonorous sounds in the sonority hierarchy. However, long vowels metathesis does not reflect a sonority-based vowels reordering. Instead, it is a strength-derived metathesis. In NA, the long low vowel /a:/ requires multiple articulators to be produced, it needs a wide-open jaw and a low tongue position. Besides, it has a very high values of formant 1, vowel height, and mid values of formant 2, vowel frontness, which reflects a need for wider articulatory excursion. In contrast, the long-rounded vowel /u:/ needs to raise the back of the tongue and rounded lips, furthermore, it has low values for formants 1 and 2 (Alammar, 2023). Therefore, the vowel /a:/ needs more efforts to be produced than other long vowels (Ladefoged & Johnstone, 2015; AL-Suliman, 2018).

Based on vowels metathesis analysis, there is a need for a markedness constraint where long vowels in disyllabic words reverse their places based on strength feature:

*LATE-STRONG-LV — Assign a violation for any strong long vowel that occurs late in the prosodic word, in inputs containing two long vowels. Thus, the order of the constraints would be as follow:

7. MAX-IO >> ONS >> *COMPLEX_{cod}, *LLL >> ALIGN-RIGHT_(SH,co) >> SCL-STOP >> LATE-STRONG-LV >> *LATE

STRONG>>SYLLCONTT>>SSP>>HOMORGANIC-LINEARITY>>DEP-IO,
LINEARITY

Table 7. SCL-STOP AND the *LATE-STRONG

Input: /du:.la:b/	MAX-IO	*LATE-STRONG-LV	LINEARITY
a) [la:b]	*!		
b) [du:.la:b]		*!	
c) ^{wa} [da:.lu:b]			*

Candidate (7a) is eliminated since there is a deletion of a whole syllable. Similarly, the faithful candidate (7b) is excluded because the strongest vowel [a:] appears late in the word. Lastly, output (7c) is the optimal since it follows the *LATE-STRONG-LV constraint.

Morphological Factors

Metathesis happens more frequently in verbs and singular nouns than in adjectives in NA. Besides, it occurs more in original Arabic words than loan ones. Typically, the roots of nouns and verbs usually consist of two to five consonant sounds where prefixes, infixes, and suffixes are added (Aldlaimi, 2004; Abu-Rabia, 2012). In NA, metathesis occurs commonly in trilateral consonant words with the pattern /fa.ʕal/, such as /χa.saf/ ‘he dropped down’ → [χa.fas]. Besides, it occurs with other trilateral forms with adding one to two sounds to the trilateral roots, as the pattern /fa.ʕil/ in /na:.ðʕidʒ/ ‘ripped’ → [na:.dʒiðʕ]. It also happens to quadrilateral roots, like the pattern /fa.ʕlal/ as in /laχ.batʕ/ ‘mixed things up’ → [χal.batʕ].

Therefore, trilateral consonant verbs motivate metathesis to occur while it happens in trilateral and quadrilateral roots for nouns. However, there is only one word that has a disagreement on its classification between Arabic grammarians, /zan.dʒa.bi:l/ ‘ginger’. Adhima (1984) considers /zan.dʒa.bi:l/ ‘ginger’ as an original Arabic word that has five consonants root with adding the vowel /i:/. In contrast, Aldlaimi (2004) classifies it as an ancient loan word that get the Arabic structure /fa.ʕla.li:l/. Furthermore, the following three words are not classified into a particular root size since they are loan words from other languages:

(4) a) /ti.ril.ju:n/ ‘trillion’ → [ti.lir.ju:n]

b) /kra:.su:n/ ‘croissant’ → [kru:.sa:n]

c) /kat.fab/ ‘ketchup’ → [kaʃ.tab]

For adjectives, there is one attested example of metathesis with five consonants root with adding the vowel /i:/, /ba.naf.sa.dʒi:/ ‘purple’ → [ba.nas.fa.dʒi:]. In addition, metathesis could occur between root segments and affixes, which contrasts with Iraqi Arabic (Jasim and Sharhan, 2013), such as /ti.-rte.ʕiʃ/ ‘she is trembling’ → [ti.tre.ʕiʃ] where the verb is derived from the triconsonantal root /rʕʃ/ ‘trembling’ in the form /ra.ʕaʃ/ ‘he is trembling’ that is structured with the pattern /fa.ʕal/. The form /if.ta.ʕaʃ/ is developed through inserting two segments to the root word to be /ir.ta.ʕaʃ/ ‘he is trembling’ with the prefix /t/ that function as a mark of feminine singular in the present tense in NA to be /ti.-rte.ʕiʃ/ ‘she is trembling’ leading to the reversed form [ti.tre.ʕiʃ].

According to Jinny and Hindawi (2008), metathesis, reordering segments, occurs based on what has been heard from Arabic native speakers, and the reordered

forms cannot be used as patterns for derivation of other words, as with the root /ktb/ to be /ka.tab/ 'he wrote', /ki.tab/ 'book', and /ka.tib/ 'writer', where the root can be used to generate multiple words with different meanings. Sequence patterns and reordering can be explained and explored but there is no fixed rule that can be used to create other forms and words with the same meaning and use of the reordered form. Consequently, the dominant factors that motivate metathesis in NA are the phenetic and phonological ones. The morphological factor does not have a clear effect on metathesis as the other two factors.

CONCLUSION

As stated earlier, the goal of this paper is to identify the phonetic, phonological, and morphological factors' influence on variant metathesis types, consonant metathesis, long vowels metathesis, and VVC metathesis, in NA. Besides, it aims to present how metathesis types can be analyzed using OT as a framework. Metathesis is a phenomenon attested through auditory transmission between Arabic speakers (Jinny & Hindawi, 2008). The study identifies the phonological and phonetic reasons and the most common morphological structures for its occurrence. The data of the study was taken from native NA speakers' public available social media, my observation, and native NA speakers' examples and was concurred by fifteen native NA speakers in Riyadh and AzZulfi.

The analysis of metathesis types from a phonological view proves that its occurrence is conditioned by ONS, *LLL, SCL-STOP and SSP. Furthermore, VVC metathesis attracts vowel epenthesis to produce easier pronunciation and movement of articulators. Phonetic factors explain why, mostly, stops and low long vowels are the sounds that get reordered to be produced first because they need more effort in production. Furthermore, sounds that share same place or manner of articulation tend to get reversed. Lastly, morphological factors present that metathesis happens more in Arabic original words than loan words. In addition, in verbs, trilateral consonant roots attract metathesis more than other root size. For nouns, it occurs in trilateral and quadrilateral with the same manner while it occurs with five consonants root for adjectives. Furthermore, phonological and phonetic factors influence reordering segments more than the morphological factor. Some words require metathesis to avoid phonological violations while others need it for phonetic ones. Its tendency in dialects is derived toward ease of articulation with providing easier order of segments to pronounce which spreads across speakers.

The current study reveals and elaborates on metathesis types in NA from phonological, phonetic, and morphological angles. However, identifying all the reordered sound patterns and the reasons behind that in a dialect or language that was not examined from this manner earlier is a complicated task to be comprehensively analyzed in a single study. In fact, the study focused on the main lines of the analysis and the possible phonological, phonetic, and morphological reasons behind metathesis types in NA. In addition, all metathesis types in NA are motivated by the SCL, SSP, and ease of articulation theories with multiple examples, however, VVC has been analyzed depending on one attested example and the same for metathesis in adjectives, thus, their analysis should not be generalized unless there are other examples to support the analysis. The findings of the study might not be generalized to all native NA speakers since the sample was limited to Riyadh and AzZulfi. However, the researcher confirmed the existence of the data in Qasimi Arabic and Hail Arabic, but there are some dialects'

differences. Consequently, further study is recommended on different types of metathesis in Qasimi Arabic and Hail Arabic to identify the reasons that motivate their occurrence. Finally, the study does not include experimental methods to analyze people's perceptions and production of metathesized words. This kind of methods in a further study would offer a more explicit view and help to determine other related reasons of metathesis and features related to the dialect's phonetic and phonological systems.

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