SYLLABLE STRUCTURE AND RELATED PROCESSES IN OPTIMALITY THEORY: AN EXAMINATION OF NAJDI ARABIC

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I would like to dedicate this work to my family and King Saud University.

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Abstract

This study is an investigation of syllable structure and related processes in one variety of Saudi Arabic. This is the variety spoken by inhabitants of Riyadh and villages near this city in Najd province, henceforth referred to as Najdi Arabic (NA). Although this dialect has been analysed by scholars including Johnstone (1963, 1967), Lehn (1967), Ingham (1971, 1982, 1994), Abboud (1979), Al-Sweel (1987, 1990), Prochazka (1988), Kurpershoek (1999), Alezets (2007), Alessa (2008), and Alghmaiz (2013), syllable structure and related processes in this dialect have not been accounted for within Optimality Theory (OT). Therefore, the main goal of this thesis is to show how OT, as an analytical framework, is utilized to produce a better understanding syllable structure and related processes such as CV metathesis, epenthesis, vowel shortening, and syncope in NA. Accordingly, the fundamental aims of this thesis are to examine phonological processes that have an impact on the syllable structure in this dialect and to show the insights about NA syllable structures and related processes that can be gained through OT analyses.

The research draws on previous work on NA as well as other Arabic varieties more generally. Thus, the theoretical literature on syllables, syllable structures and syllable typologies are taken into consideration in the analysis of NA data. The data for this study are drawn from articles, essays, theses, and journals. These sets of data underwent my own judgment as an NA native speaker. In addition, 15 native speakers of NA were interviewed and consulted on the NA set of data in this thesis.

There are four findings in this study. The first deals with the comprehensive analysis of syllable structure in NA, focusing on the types of onsets and codas as well as the weight of syllables in this dialect. The second extends to the comprehensive analysis that deals with the main phonological processes in NA, focusing on CV-metathesis, epenthesis, vowel shortening, and syncope. The third sheds light on the unified set of OT constraints that has been established to explain NA syllable structure and related processes within OT. Finally, the capability of OT to account for cross-linguistic variation is demonstrated by showing how language-specific constraint rankings based on one set of constraints accounts for CV metathesis, vowel epenthesis, and syncope in Najdi and Urban Hijazi Arabic (UHA).

List of Abbreviations

The following abbreviations are used in the gloss and the text.

p^h	aspiration
BHA	Bedouin Hijazi Arabic
Can	Candidate
Cat	Category
CA	Classical Arabic
COD	Coda
CL	Compensatory Lengthening
cf.	confer (compared to)
C	consonant
Cons.	consonantal
CON	constraint
CONTIG	Contiguity
DEP	Do not epenthesise (no insertion)
v	epenthetic vowel
,	equally ranked
EVAL	evaluator
etc	etcetra (and so on)
e.g.	exempli gratia (for example)
< >	extrametrical segment
!	fatal violation or imperative
C1	First consonant
☹	wrong output selected as optimal
f.	feminine
Fig.	figure
F or Ft	foot
FTBIN	foot binary
G	geminate
GEN	generator
Hd	head
/ /	input
IO	Input and Output
→	leads to (right arrow)

a:	long vowel (monothong)
m	male
☆	manner of articulation
ms.	masculine
MHA	Medinah Hijazi Arabic
MSA	Modern Standard Arabic
μ	Mora
>>	more highly-ranked
Mwd	Morphological word
NA	Najdi Arabic
n	Noun
N	nucleus
NUC	Nucleus or nuclei
Ø	null element (empty slot)
OBJ	Object suffix
OCP	Obligatory Contour Principle
ONS	Onset
☞	optimal candidate
OT	Optimality Theory
[ ]	Output
P	Peak
Pl.	Plural
POSS	Possessive suffix
PrWd	Prosodic word
ω	Prosodic word
R	rhyme or right
C2	Second consonant
sg.	Singular
SLH	Strict Layering Hypothesis
SONSEQ	Sonority Sequencing
SSG	Sonority Sequencing Generalization
SSP	Sonority Sequencing Principle
ˈ	Stress
σ	Syllable
SUB	Subject agreement suffix

.	syllable boundary
$	syllable boundary in sonority representation
SYLLCON	Syllable Contact
SYLL-MAX	syllable maximality
SYLL-MIN	syllable minimality
TA	Taifi Arabic
X	Timing slot or any [-cons] segment
TSE	Trisyllabic Elision
*	ungrammatical form, not lexicon, or constraint violation
UG	Universal Grammar
UHA	Urban Hijazi Arabic
V	Vowel
WSP	Weight-to-Stress –Principle
Wd	Word
#	word boundary
Wd-Int	Word Internal

List of OT constraints

*3μ (Kager 1999):

No trimoraic syllables.

*CVV.CV]$_{\sigma}$

The unstressed light penultimate syllable that follows a heavy antepenultimate syllable of the form CVV is not allowed.

*CLASH (Kager 1999):

No adjacent syllables are stressed.

*CODA (Prince and Smolensky 2004):

Syllables must not have codas.

*COMPLEX$_{ONS}$ (Prince and Smolensky 1993):

A syllable must not have more than one onset segment.

*COMPLEX$_{COD}$ (Prince and Smolensky 1993):

A syllable must not have more than one coda segment.

DEP-IO (McCarthy & Prince 1995):

Every segment of S_2 has a correspondent in S_1 (S_2 is "dependent on" S_1).

FINAL-C-μ (Hayes 1989)

Word-final coda consonants are weightless.

*FINAL-G

Word-final geminates are prohibited.

$*i]_\sigma$ (Kenstowicz 1996):

High short unstressed vowels in open syllables are not allowed.

*LLL:

Assign one violation mark for three light syllables.

*LENITION-GUTTRAL:

The manner of articulation of gutturals should not be changed to a vowel-like (more sonorous) one.

LINEARITY (Pater 1995):

S_1 reflects the precedence structure of S_2, and vice versa.

MAX-C (McCarthy 2008):

Consonant deletion is prohibited.

MAX-IO (McCarthy & Prince 1995):

Every segment of S_1 has a correspondent in S_2.

MAX-μ-IO (McCarthy & Prince 1995, Moren 1999)

Every mora in S_1 has a correspondent in S_2 (no deletion of moras).

No [a] (Orgun 1995):

/a/ is not allowed in light syllables.

No [u]:

/u/ is not allowed in light syllables.

O-CONTIG (CONTIGUITY-IO) (“No Insertion”) (McCarthy& Prince 1995):

The portion of S2 standing in correspondence forms a contiguous string.

ONSET (ONS) (Prince and Smolensky 1993):

Syllables must have onsets

SONORITY SEQUENCING PRINCIPLE (SSP) (Roca 1994):

The sonority profile of the syllable must slope outwards from the peak.

Syllable Contact (SYLLCON) (Bat El 1996:302):

The onset of a syllable must be less sonorous than the last segment in the immediately preceding syllable, and the greater the slope in sonority the better.

*[VOCELESS PLOSIVES *[VP

A sequence of voiceless plosives in the initial position assigns one violation mark.

VOWEL ABLAUT (VA)

The shortened vowel that results from the attachment of a consonant-initial subject agreement suffix should undergo vowel ablaut (vowel alternation).

WSP (Weight-To-Stress-Principle) (Prince & McCarthy, 1995 2004):

Heavy syllables are prominent both on the grid and foot structure.

Chapter 1. Introduction

This thesis sheds light on the syllable structures found in Najdi Arabic and how they are accounted for within the framework of Optimality Theory (OT). Moreover, other processes related to the change of syllable structure will be examined in this thesis such as metathesis, epenthesis, vowel shortening, and syncope. In other words, phonological processes relative to syllable structure will be examined in detail and accounted for within OT. Accordingly, the fundamental aims of this thesis are to examine phonological processes that have an impact on the syllable structure in this dialect and to show the insights about NA syllable structures and related processes that can be gained through OT analyses. To achieve these aims, there are five necessary questions to address in this thesis:

1) What insights about Najdi syllable structure and related processes can be gained through Optimality Theory?
2) What is the source of initial bi-consonantal clusters in Najdi Arabic?
3) To what extent are sonority violations tolerated in final consonant clusters in Najdi?
4) How are non-final superheavy syllables of the forms CVVC and CVCC avoided in Najdi?
5) What are the motivating factors for vowel shortening in NA?

Before addressing the questions above, I will briefly indicate the province where this dialect is spoken and the significance of this study. Then, I will demonstrate consonant and vowel inventories in this dialect along with some phenomena such as the treatment of the glottal stop, affrication, vowel raising, and vowel lowering. The significance of this study will be illustrated after vowel and consonant inventories are discussed. Finally, I will demonstrate how data sources are collected followed by an overview of all chapters in this thesis. The location of Najdi Arabic will be illustrated in the next section.

1.1 Where Najdi is spoken

Najdi Arabic is a dialect spoken by people who live in Najd province, the middle region of the desert part of Arabia constituting today's Saudi Arabia (Al-Sweel, 1987). Najd is locally used to refer to the area from Yemen to the south, to the borders of Jordan to the north, and from Ahsa oasis to the east, to the mountains of Hijaz and the plains of Asiir to the west (Al-Sweel, 1987). Despite defining a geographic location where Najdi is spoken, Ingham (1994) states that Najdi Arabic is not simply one dialect, but rather the name refers to a relatively homogenous cultural group of dialects which can be termed the Najdi dialects: these dialects firstly include the speech of non-nomadic people from the areas of Central Najd (the district of al-Ārid, al-Washm and Sudair), from Qassim and Jabal Shammar to the north and from Najran and Bisha to the South. Secondly, these dialects, as Ingham (1994) observes, also include the speech of Bedouin tribes who live in these areas; therefore Najdi also includes the dialects of tribes who live in the centre of Najd such as Anizah , Utaibah, Subai, Suhul, Bugum, Dawasir, Harb, Mutair, Awawzim and Rashayidah. The speech of the Shamar and Dhafīr tribes from the north of the Arabian Peninsula are also counted among the Najdi dialects as well as the speech of Ghatan and Āl Murrah and Ajmān in the south and east of the Arabian Peninsula. Thirdly, according to Ingham (1994), Najdi dialects include the speech of émigré Bedouin tribes who live in the Syrian Desert and those who live in the Jazirah of Iraq (of Anizah and Shammar extraction). While the dialects of Bedouins are seen as an overspill of Najdi type into the surrounding area of Najd, the Najdi dialect can geographically be seen in the Central Najd and Jabal Shammer where the non-nomodic people speak it (Ingham 1994). In fact, Ingham (1994) locates the borders of the Najd dialect area as the sand desert ring formed by Nufūd to the north, the Dahana to the east and Rub'al-Khāli to the south. However, it is less easy to locate the borders of Najdi dialect areas to the west because here it begins to coalesce into the Hijāz (Ingham 1994). The areas that span Hijaz and Najd are traditionally occupied by the major tribes of Utaibah and Harb. Utaibah occupies the east of Mecca, whereas Harb occupies east of Medīnah (Ingham 1994). (see fig.1)

Figure 1.1 Najd province

According to Ingham (1994), the main linguistic differences between the three primary Najdi groups rest with morphology. The phonology, on the other hand, as well as the syntax and grammar, is relatively uniform. My central focus in this thesis will be on the syllable structure of the central Najdi group (rather than the Northern and Southern groups), since central Najdi represents the standard Saudi dialect.

1.2 Significance of the study

Najdi Arabic (NA) has been analysed by scholars including Johnstone (1963, 1967), Lehn (1967), Ingham (1971, 1982, 1994), Abboud (1979), Al-Sweel (1987, 1990), Prochazka (1988), Kurpershoek (1999), Alezets (2007), Alessa (2008), and Alghmaiz (2013). Johnstone (1963, 1967) and Ingham (1982) focused on the affrication in Najdi Arabic and the syllabification in the spoken Arabic of Aniza. Furthermore, Ingham (1971) compared the characteristics of speech in the Arabic of Mecca and Aniza such as the types of consonants in dialects, anaptyctic vowels (vowel epenthesis), shortening of long vowels, and elision of short vowels. Vowel contrasts in NA were taken into consideration by Lehn (1967) and Al-Sweel (1987, 1990). In particular they highlighted the cases that motivate vowel raising and lowering in NA. Abboud (1979) identified the syllabification and stress parameters of verbs in Northern Najdi Arabic, as did Prochazka (1988). Prochazka (1988) and Ingham (1994) adhered to Johnstone (1963, 1967), Lehn (1967), Abboud (1979), and Al-Sweel (1987) in order to gather some information about Najdi phonology in general. In other words, they referred to scholars like Johnstone (1963, 1967), Lehn (1967), Abboud (1979), and Al-Sweel (1987) to present general ideas about phonological aspects in NA such as consonants, vowels, anaptyctic vowels (vowel epenthesis), deletion, and so on. Kurpershoek (1999) accounted for vowel shortening in hollow verbs in NA that would result from changing the verb form to imperative. On the other hand, Alezetes (2007) concentrated on the syllable structure in NA in terms of the acquisition of English syllable structure by Najdi native speakers, whereas Alessa (2008) described how Najdi dialect changes when the speakers of this dialect communicate with the speakers of Urban Hijazi Arabic (UHA) in Jeddah. The recent research on NA which has been done by Alghmaiz (2013) is specific to initial consonant clusters found in this dialect. However, none of the existing scholarship addresses the syllable structure and related processes in NA in light of OT (Optimality Theory). In other words, the syllable structure and related processes such as CV metathesis, epenthesis, vowel shortening, and syncope have not been accounted for within OT.

Therefore, this study will be an attempt to examine the syllable structure and related processes in Najdi through the framework of OT to underscore how these processes are, in fact, related to syllable structure. In this regard, OT is an ideal vehicle to show such relatedness. This framework will be used to compare CV metathesis, vowel epenthesis, and syncope in NA and UHA in order to show how this theory is capable of accounting for cross-linguistic variations.

1.3 Consonant Inventory in NA

The consonants of NA will be discussed in detail in terms of place and manner of articulation. As an overview, the entire inventory of consonants in NA are gathered in the table below and represented conventionally by place and manner of articulation:

Table 1.1 The manner and place of articulation of consonants in Najdi Arabic

	Bilabial	Labio-dental	Dentals	Emphatic interdental	Alveolar	Emphatic alveolar	Alveo-palatal	Palatal	Velar	Uvular	Pharyngeal	glottal
Plosive	b				t d	tˤ			k g	q		ʔ
Fricative		f	Θ ð	ðˤ	s z	sˤ	ʃ			χ ʁ	ħ ʕ	h
Affricate			ts dz				ʤ					
Nasals	m				n							
Lateral					l							
Flap					r							
Glides	w							j				

According to the table of consonants above, this dialect shares some consonants with their counterparts in CA (Classical Arabic) and MSA (Modern Standard Arabic); indeed, the vast majority of sounds in NA are counterparts of those in CA and MSA (Abboud 1979 & Ingham 1994). These sounds are /b/, /f/, /θ/, /ð/, /t/, /d/, /s/, /z/, /tˤ/, /sˤ/, /ðˤ/, /ʃ/, /χ/, /ʁ/, /k/, /ħ/, /ʕ/, /h/, /r/, /l/, /n/, /m/, /w/, /j/, and /dʒ/. There are some types of gutturals in NA that have counterparts in CA and MSA; emphatic gutturals are /tˤ/, /sˤ/, and /ðˤ/. Non-emphatic gutturals are /χ/, /ʁ/, /ħ/, /ʕ/, /ʔ/, and /h/.[1] However, there are some sounds in both CA and MSA which are not found in NA such as the alveolar emphatic voiced stop /dˤ/, for which NA uses the interdental fricative voiced /ðˤ/, according to Ingham (1994) and Feghali (2004). Furthermore, Ingham (1994) notes that

[1] Zawaydeh (1999:23) defines gutturals as "a group of sounds that have a constriction in the back part of the vocal tract".

the voiceless unaspirated uvular stop /q/ in CA and MSA is realized as /g/, a voiced velar plosive, in NA, and the medial glottal stop is absent from Najdi, except in words considered to be borrowed from CA, such as /roʔja/ ‘vision’; /qur.ʔa:n/ ‘Qur’an'. For example, the medial glottal stop (Hamza in Arabic) is replaced by a long vowel /a: / in words such as [ra:s] ‘head’ and [ði:b] ‘wolf’; i.e. /raʔs/→ ‘head’ and /ðiʔb/→ [ði:b] ‘wolf’. Also, /k/ and /g/ are realised as [ts] and [dz] in NA. With respect to Ingham's (1994) findings, he did not discuss what factors are responsible for changing the segments /k/, /dˤ/, /g/, /q/, and /ʔ/ in Najdi. In other words, he did not state that the change in these segments is specific to the manner of articulation. For instance, /dˤ/, as an alveolar emphatic voiced stop, is changed to an emphatic fricative voiced /ðˤ/. Likewise, /q/, as a uvular voiceless stop, is changed to a velar voiced stop /g/. However, /g/ is changed to /dz/, as a voiced dental affricate. /k/, as a velar voiceless stop, is changed to /ts/, as a dental voiceless affricate. Now, the question is which phonological factor accounts for these changes. These changes lead to identifying a phonological factor known as lenition which is illustrated in the next subsection. In the next subsection, I will clarify that vowel lengthening in Najdi Arabic results from realising a medial and final glottal stop as vowels identical to stem vowels.

1.3.1 Lenition in Najdi Arabic

Lenition (weakening) is defined by Trask (2000:190) as “any phonological change in which a segment becomes less consonant-like than previously.” Escurs (1977) shows a scale in (1.1) which represents lenition and fortition; lenition represents a change from voiceless stops to voiced ones while the opposite process is interpreted as fortition:

(1.1) Fortition	6	voiceless stops
	5	voiced stops /voiceless fricatives
	4	voiced fricatives
	3	nasals
	2	liquids
	1	glides
Lenition	Ø	

It is clear from the scale above that lenition (weakening) and fortition (strengthening) are processes that can be used to describe segments in this manner. A consonant becomes weaker the more it comes to resemble a vowel, whereas a consonant becomes stronger the more it becomes different from being vowel-like. With respect to Escure (1977), there are two issues with the scale of lenition and fortition above: firstly, Escure (1977) did not mention where voiced and voiceless affricates are placed in this scale. Secondly, according to him, voiceless fricatives are equally low in sonority. However, Parker (2008) disagrees with the idea that voiced stops are equally as sonorous as voiceless fricatives.[2] Furthermore, he presents a new sonority scale that includes types of vowels and affricates, as in (1.2) below:[3]

(1.2) Most sonorous

Low vowels
Mid vowels
High vowels
Glides
Liquids
Nasals
Voiced fricatives
Voiced affricates
Voiced stops
Voiceless fricatives
Voiceless affricates
Least sonorous — Voiceless stops

According to the sonority scale above, the strongest segments are voiceless stops since they are the least sonorous. Segments in the sonority scale above are distributed in the lenition and fortition scale in (1.3) below:

[2] Parker (2008) refers to Goldsmith (1990), Hankamer & Aissen (1974), Itô (1982), and Lass (1984) who state that affricates are ranked between stops and fricatives.
[3] Parker (2002, 2008) argues that this sonority scale is universal since some languages require the scale to be further subdivided at various points, especially obstruents including fricatives, affricates, and plosives (cited in Melick 2012: 46).

(1.3) Lenition and Fortition scale:

Fortition ↑	9	Voiceless stops
	8	Voiceless affricates
	7	Voiceless fricatives
	6	Voiced stops
	5	Voiced affricates
	4	Voiced fricatives
	3	Nasals
	2	Liquids
↓	1	Glides
Lenition	Ø	

In NA, lenition is responsible for changing the manner of articulation of the segments /k/, /dˤ/, /g/, and /q/. For example, lenition represents a change from a voiceless uvular stop /q/ to a velar voiced stop /g/ because a voiced stop /g/ is weaker than the voiceless stop /q/.[4] Likewise, changing from /dˤ/, as an alveolar emphatic voiced stop, to an interdental emphatic fricative voiced /ðˤ/ is considered to be lenition due to a fricative voiced being weaker than a voiced stop, according to the lention and fortition scale in (2.3). In Najdi, lenition is also observed when changing some segments from stops to affricates; e.g., /g/→ [dz] and /k/ → [ts]. Voiced affricates are weaker than voiced stops, and voiceless affricates are weaker than voiced stops. How do segments /k/ and /g/ shift to [ts] and [dz]? The examples shown in (1.4) answer this question:

[4] Teifour (1997) adheres to Katamba (1989) in order to show lenition in Syrian Arabic. He states that lenition in this dialect occurs when changing segments from voiceless to voiced which means that this behaviour is merely defined as the transition from less sonorous to more sonorous. Therefore, voiceless consonants are less sonorous than voiced ones, according to Katamba (1989). This idea suggests that sonority is related to voicing.

(1.4)

I.

a. /**<u>ka</u>**tf/→ [**<u>tsa</u>**tf] ‘shoulder’

b. /**<u>ki</u>**.bi:r/ → [**<u>tsi</u>**.bi:r] ‘big’

c. /**<u>ka</u>**bd/→ [**<u>tsa</u>**bd] ‘liver’

d. /m**<u>ig</u>**.bil/→ [m**<u>idz</u>**.bil] ‘coming (ms. sg.)’

e. /**<u>gi</u>**b.lah/→ [**<u>dzi</u>**b.lah] ‘a direction to pray’

II.

a. /**<u>ga:</u>**l/→ [**<u>ga:</u>**l] /*[dzaal] ‘he said’

b. /ʃ**<u>a:k</u>**/→ [ʃ**<u>a:k</u>**]/* [ʃaats] ‘he suspects’

c. /sim**<u>ak</u>**/→ [sim**<u>ak</u>**] /* [simats] ‘fish’

d. /m**<u>ak</u>**.su:r/→ [m**<u>ak</u>**.su:r] /*[mats.su:r] ‘it (ms. sg.) got broken’

e. /m**<u>ag</u>**.bu:l/→ [m**<u>ag</u>**.bu:l]/ * [m**<u>adz</u>**.bu:l] ‘accepted (ms. sg.)’

According to Johnstone (1963), Ingham (1982, 1994), and Prochazka (1988), in (1.4-I), /k/ shifts to [ts] in the onset position when preceding the vowels /a/ and /i/; e.g., /**<u>ka</u>**tf/→ [**<u>tsa</u>**tf] ‘shoulder’.[5] /g/ is realised as [dz] in the onset position if it precedes the front vowel /i/ and in the coda position if /g/ is preceded by the vowel /i/; e.g., /**<u>gi</u>**b.lah/→ [**<u>dzi</u>**b.lah] ‘a direction to pray’, and /m**<u>ig</u>**.bil/→ [m**<u>idz</u>**.bil]. However, in (1.4-II), there is an exceptional case in which the consonants /k/ and /g/ remain unchanged. For instance, /g/ does not shift to [dz] because it does not follow a fronting vowel /i/; e.g., /m**<u>ag</u>**.bu:l/→ [m**<u>ag</u>**.bu:l]/ *[m**<u>adz</u>**.bu:l] ‘accepted (ms. sg.)’. In addition, the same segment is preserved in the onset position, because it does not precede a front vowel /i/; e.g., /**<u>ga:</u>**l/→ [**<u>ga:</u>**l] /*[dza:l] ‘he said’. Similarly, /k/ does not shift to [ts] in the coda position; e.g., /ʃ**<u>a:k</u>**/→ [ʃ**<u>a:k</u>**]/*[ʃa:ts] ‘he suspects’, and /sim**<u>ak</u>**/→ [sim**<u>ak</u>**] /* [simats] ‘fish’. In table (1.2), there is a comparison between affrication in CA and NA:

[5] There is another exceptional case in NA in which /k/ does not shift to [ts], even if it is preceded by a front vowel /i/; e.g., /**<u>ki</u>**.sar/→ [**<u>ki</u>**.sar] /*[tsi.sar] 'he broke'

Table 1.2 Comparison between Affrication in CA and NA

CA	NA	Gloss
/qib.lah/	/gib.lah/→ [dzib.lah]	‘a direction to pray’
/muq.bil/	/mig.bil/→ [midz.bil]	‘coming (ms. sg.)’
/ka.bi:r/	/ki.bi:r/→ [tsi.bi:r]	‘big’
/katf/	/katf/→ [tsatf]	‘shoulder’
/kabd/	/kabd/→ [tsabd]	‘liver’

The table above shows that the voiceless unaspirated uvular stop /q/ in the input /qib.lah/ and /muq.bil/ in CA is changed to the voiced velar stop /g/ in the input /gib.lah/ and /mig.bil/ in NA. The voiced velar stop /g/ is changed to a voiced dental affricate [dz]; e.g., [dzib.lah], [midz.bil]. While the voiceless velar stop /k/ in the input /ka.bi:r/, /katf/, and /kabd/ in CA is changed to the voiceless dental affricate in NA.

With respect to Johnstone (1963), Ingham (1982, 1994), and Prochazka (1988), I have observed that the realisation of /k/ and /ts / is found in Qassim and some towns near to Qassim such as ALZULFI, ALGHATT, and so on, whereas the speakers of NA in Riyadh still produce/k/ and /g/. Furthermore, some of the speakers of NA in Riyadh produce the sound /q/ initially in some words such as [qa:no:n] ‘law’ , [qara:r] ‘decision’, and so on. My observation is supported by Feghali (2004:66) who mentions that the sound /q/ is still preserved in Riyadh and Eastern Saudi Arabia dialects in certain words only; e.g., [qurʔa:n] ‘Qur'an’. Moreover, Al-Azraqi (2007) notes that urbanisation and education policy play a role in retaining these segments; for example, education policy encourages the official use of Classical Arabic (CA) officially in schools. She also concludes that educated speakers are more likely to produce these segments than less-educated individuals. The word [qur.ʔa:n] retains a medial glottal stop while this consonant is deleted in [ra:s] ‘head’ and [ði:b] ‘wolf’. The next subsection will address why this is the case.

1.3.2 The treatment of the glottal stop in Najdi

A glottal stop is found in Najdi in the initial position as an underlying phoneme which functionally helps to avoid onsetless syllables in this dialect in particular. In other words, an underlying glottal stop is preserved in the onset position; otherwise, the deletion of this glottal stop leads to the deletion of an onset which is prohibited in modern Arabic dialects in general and therefore also in this dialect in particular. What this means is that deletion of this underlying glottal stop violates the Onset Principle (Itô,1989) which says that syllables that lack onsets should be avoided. Bakalla (1973), Abboud (1979), and Abu-Mansour (1987) state that a glottal stop is available in the onset position to avoid onsetless syllables in most modern Arabic dialects. Consider the following examples in (1.5):

(1.5) Glottal stop in the onset position in NA

a. /ʔakil/→[ʔakil] 'food' cf. *[akil]
b. /ʔa.mar.na/→[ʔa.mar.na] 'we ordered' cf. *[a.mar.na]
c. /qur**ʔ**aːn/→[qur.**ʔ**aːn] 'Qur'an' cf. *[quraːn][6]

In the examples above, a glottal stop is not syncopated since it is in the onset position in the final syllable. This means that the deletion of this consonant would result in the lack of an onset.

However, according to Abboud (1979), a glottal stop is not underlying in some imperative forms, because it is inserted with a prosthetic vowel in order to avoid certain initial consonant clusters like /sm-/, /ʤm-/, /zr-/, /ft-/, and so on. A prosthetic vowel is inserted to break some initial consonant clusters and a glottal stop is preceded by a prosthetic vowel to avoid onsetless syllables. Brame (1970), Benmamoun (1996), Al-Shboul (2007), Rakhieh (2009), and Alghmaiz (2013) report that a glottal stop with a prosthetic vowel /i/ is inserted in some imperative forms to avoid both initial consonant clusters like /sm-/, /ʤm-/, /zr-/, /ft-/ and onsetless syllables (see subsection 3.2.2). Consider the following examples:

[6] Some speakers of Najdi, especially non-educated or older people, rarely produce the same word without a medial glottal stop; i.e, /qur**ʔ**aan/→ [gu.**rʕ**aan] → [gu.raan]. What this means is that a glottal stop in this case becomes an easy target for syncope since it is in a pre-consonantal position.

Table 1.3 Some imperative forms in NA

Input	Output (imperative)	Gloss
a. /ʤmaʕ/	[ʔiʤ.maʕ] / *[iʤ.maʕ]	‘Collect! (ms.)’
b. /smaʕ/	[ʔis.maʕ] / *[is.maʕ]	‘Listen! (ms.)’
c. /zraʕ/	[ʔiz.raʕ] / *[iz.raʕ]	‘Plant! (ms.)’
d. /gtˤaʕ/	[ʔig.tˤaʕ] / *[ig.tˤaʕ]	‘Cut! (ms.)’
e. /sʔal/	[ʔis.ʔal]/ *[isʔal]	‘Ask! (ms.)’

Similarly, a prosthetic vowel /i/ and a glottal stop are inserted in verbs that are derived from certain triliteral verbs like /nfaʕal/, /ftaʕal/ and /stafʕal/; e.g., /nkatab/→ [ʔin.katab], /kta.tab/→ [ʔik.ta.tab] ‘he registered’, and /stak.tab/→ [ʔis.tak.tab] ‘he received’. These phenomena will be analysed within OT in subsection 5.3.1.

An underlying glottal stop is targeted by syncope in connected speech.[7] Consider the following table:

Table 1.4 The treatment of the glottal stop in isolated words and connected speech in NA

Isolated words	Connected speech
a. /min/ ‘who’ /ʔalli/ ‘that’ /ʤaa/ ‘came’	/minalli ʤaa/ ‘who came?’
b. /min/ ‘who’ /ʔana/ ‘I’	/minana/ ‘who am I’
/biʕt/ ‘I sold’ c. /ʔal-beet/ ‘the house’	/biʕtalbeet/ ‘I sold the house’
d. /ʃift/ ‘I saw’ /ʔannas/ ‘the people’	/ʃiftannas / ‘I saw the people’

A glottal stop in the words above is targeted by syncope in connected speech. A coda of the preceding syllable is resyllabified as an onset of the following syllable. As a result, a glottal stop undergoes deletion in connected speech in the table above. Similarly, in

[7] Connected speech is not central to this thesis.

colloquial Egyptian Arabic, Salem (2005) states that a glottal stop, which is found in the definite article /ʔal-/, is prominently deleted in connected speech; e.g., /tid.χul/ 'enter' /ʔil.mi.na/ 'the port'→ [tid.χu.lil.mi.na] 'enter the port',

Bakalla (1973) and Abu-Mansour (1987) note that a medial glottal stop is replaced by the copying of a stem vowel (vowel lengthening). Consider the examples below:

(1.6) The deletion of the medial glottal stop in Meccan Arabic

a) /ʔa-**<u>ʔk</u>**ul/→ [ʔa:kul] 'I eat'

b) /na-**<u>ʔk</u>**ul/→ [na:kul] 'we eat'

c) /ta-**<u>ʔk</u>**ul/→ [ta:kul] 'you (ms. sg.) eat'

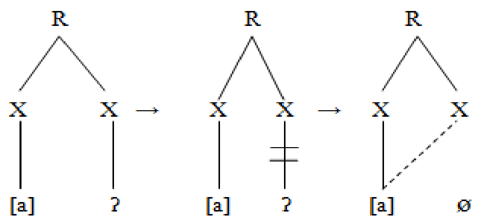
d) /ja-**<u>ʔk</u>**ul/→ [ya:kul] 'he eats'

e) /ʔa-**<u>ʔm</u>**an/→ [ʔa:man] 'he believed'

f) /ma-**<u>ʔm</u>**uur/ → [ma:muur] 'ordered'

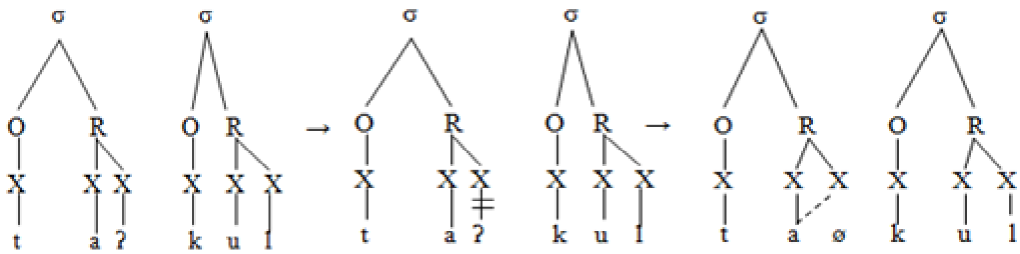
Bakalla (1973) and Abu-Mansour (1987) argue that the reason for glottal stop deletion in the examples in (1.6) is because the glottal stop is in a preconsonantal position. Thus, a medial glottal stop in the word /ta-**<u>ʔm</u>**ir/ 'you (ms. sg.) order' in NA is deleted because it is in a preconsonantal position; e.g., /ta-**<u>ʔm</u>**ir/→ [ta:mir] 'you (ms. sg.) order'. Final glottal stop in NA is also deleted in a word like /laʔ/ 'no'; e.g., /laʔ/→ [la:] 'no'. Abu-Mansour (1987) notes that a glottal stop is deleted whenever it closes a syllable; i.e., when a glottal stop forms a coda of a syllable. Thus, the glottal stop in the word /laʔ/ is in the coda position, and it is deleted in NA and Meccan Arabic: e.g., /laʔ/ → /la:/ 'no'. However, this raises the question of why a stem vowel is lengthened when a glottal stop is deleted? Bakalla (1973) and Abu-Mansour (1987) refer to Compensatory Lengthening (CL) when accounting for Meccan Arabic. Abu- Mansour (1987:268-269) says that **"**a glottal stop following a vowel is deleted when it closes a syllable, and that reassociation of the empty slot results in lengthening of the preceding vowel**"**. The autosegmental version of this rule is shown by Abu-Mansour (1987) below:

(1.7) Autosegmental version of CL:



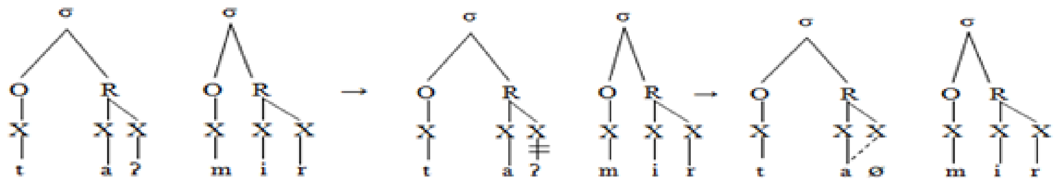
This rule has been applied to a glottal stop in the words in (1.7). A stem vowel is lengthened when a glottal stop is deleted. As an example, consider vowel lengthening in the output [ta:.kul] below:

(1.8) /ta-**<u>ʔk</u>**ul/→[ta:kul]



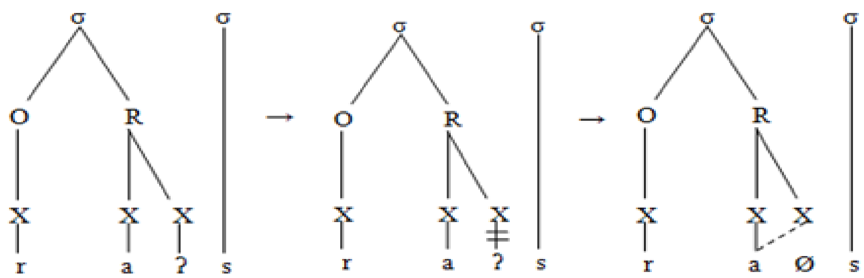
In the representation below, I show how /ta-**<u>ʔm</u>**ir/ becomes [ta:.mir] by the autosegmental version of the CL rule:

(1.9) /ta-**<u>ʔm</u>**ir/→ [ta:.mir]

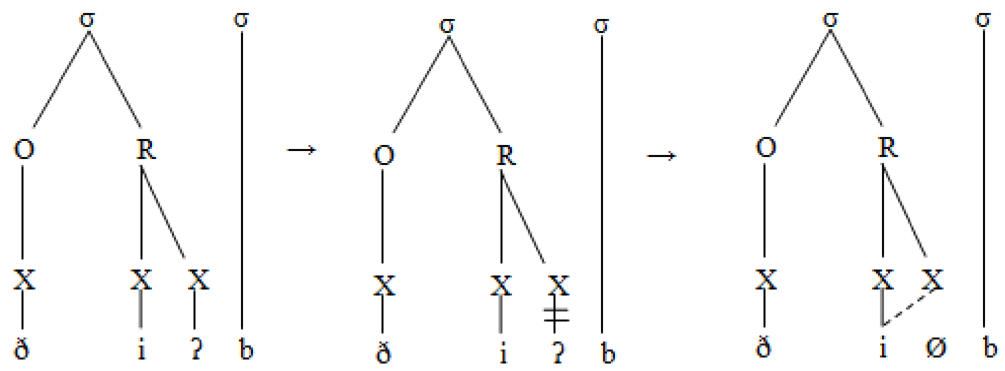


A medial glottal stop in NA is lost in monosyllabic words like [ra:s] ‘head’ and [ði:b] ‘wolf’; e.g., /raʔs/→ [ra:s] ‘head’ and /ðiʔb/→ [ði:b] ‘wolf’. Bakalla (1973), Abu-Mansour (1987) and Harrama (1993) shed light on the loss of a glottal stop in a complex rhyme in monosyllabic nouns. According to them, a glottal stop in /raʔs/ and /ðiʔb/ is in the rhyme position, and it has been synchronically deleted and an empty slot is filled with a copy of the stem vowel (lengthening). The rule of CL is applied to a glottal stop in these words below:

(1.10) a./raʔs/→[ra:s]



b. /ðiʔb/→ [ði:b]



The representations in (1.10) are deemed the answer to the question in (1.3.1) related to the reason for the deletion of a glottal stop in the rhyme position. However, a medial glottal stop in the word /qur.ʔa:n/ is not targeted by deletion since this word is borrowed from CA and is quite frequent.

A medial glottal stop, a non-emphatic guttural as described in section 1.3, is glided when it is flanked by a long vowel plus a short vowel, or a short vowel plus a long vowel (Harrama 1993). This claim is verified by the examples in (1.11):

(1.11)

a. /muru:ʔa/→ [muru:wa] ‘a sense of honour’

b. /ðiʔa:b/→ [ðija:b] ‘wolves’

c. /riʔa:sa/→ [rija:sa] ‘leadership’

The examples above demonstrate that a glide results from a glottal stop flanked by vowels or preceded by a long vowel. A medial glottal stop in (1.11a) changes to a glide /w/ when it follows a long vowel /u/ and is followed by a short vowel /a/.[8] Additionally, a medial glottal stop in (1.11b-c) is realised as a glide /j/ because it follows a short vowel /i/ and is preceded by a long vowel /a:/; although glides are deemed semi-vowels,the difference between them is attributed to the articulators responsible for producing them as described in section (1.3). For instance, the glide /j/ is produced by a soft-palatal while a glide /w/ is produced by lips. A medial glottal stop in (1.11d) follows a different rule from the others. This glottal stop is replaced by a glide /j/ when

[8] Harrama (1993) notes that a glottal stop changes to a glide /w/ if it is preceded by a short vowel /u/ and to a glide /j/ if it is preceded by a vowel /i/.

it precedes a consonant and is followed by a long vowel /a:/. There is another phenomenon in which a medial glottal stop in NA changes to a geminate glide /y/ in the word /mi**ʔ**ah/ ‘a hundered’. This change is expressed in terms of derivational rules by Shāhīn (1966) and Cadora (1989):

(1.12)

Underlying form: /mi**ʔ**ah/
↓
Gliding: [mijah]
↓
Stress placement: [míjah]
↓
Gemination: [míjjah]

As shown in the rules above, firstly, a medial glottal stop is glided when it is flanked by non-identical vowels like /i/ and /a/. This rule is given by Shāhīn (1966) and Cadora (1989), as in (1.13) below:

(1.13) Gliding rule:

a. /ʔ/→ j / i _ a

After gliding a medial glottal stop, a medial glide is geminated due to a stressed vowel that is preceded by this glide. This rule of gemination is introduced by Shāhīn (1966) and Cadora (1989):

(1.14) The rule of gemination

ij→jj / V́ _ V

There is another type of behaviour related to changing a final glottal stop to a geminate glide. This behaviour is commonly found in some words in NA as well as in Al-Jabal dialect in Libya, according to Al-Mozainy (1981) and Harrama (1993). Consider the following examples below:

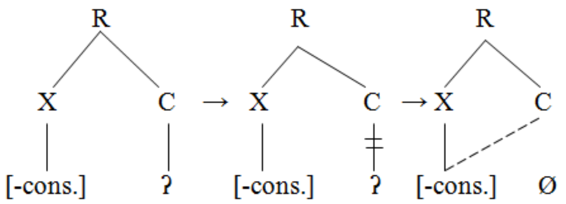
(1.15)

a. /ʃajʔ/→ [ʃajj] ‘thing’

b. /ðˤawʔ/→ [ðˤaww] ‘light’

A final glottal stop that precedes a glide undergoes Compensatory Lengthening (CL) since a glide is [-consonant], according to Abu-Mansour (1987). This rule is shown below (Note that R stands for rhyme and X stands for any [-consonantal] segment):

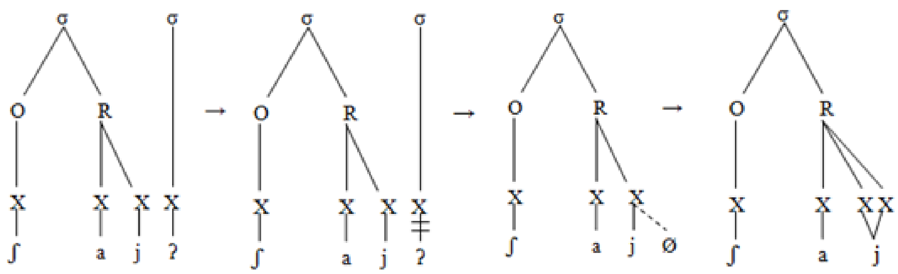
(1.16)



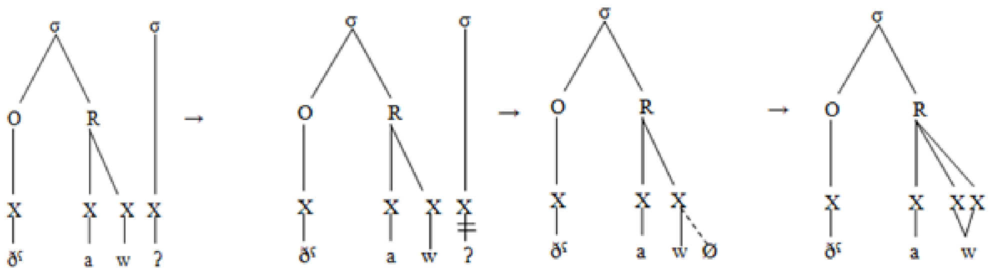
The representations of the output of /ʃajʔ/ and /ðˤawʔ/ are shown in (1.17) below:

(1.17)

a. /ʃajʔ/ → [ʃaj:] ‘thing’



b. /ðˤawʔ/→ [ðˤaw:] ‘light’



To sum up, an underlying glottal stop is preserved when it is in the onset position. Otherwise, the deletion of this consonant, as an underlying phoneme, results in onsetless syllables which are not permitted in this dialect in particular (Bakalla 1973; Abboud 1979; Abu-Mansour 1987; Itô 1989); e.g., [ʔakil] ‘food’ cf. *[akil]. In contrast, a glottal stop with a prosthetic vowel are inserted to break up consonant clusters that are found in some imperative forms and which are not tolerated in NA in particular (Brame 1970;

Benmamoun 1996; Al-Shboul 2007; and Rakhieh 2009); e.g., /ʤmaʕ/→[ʔiʤmaʕ] ‘collect! (ms.)’. Furthermore, the same prosthetic vowel with a glottal stop, which are not underlying, are used to break up some consonant clusters found in some verbs that are derived from certain triliteral verbs like /nfaʕal/, /ftaʕal/ and /stafʕal/; e.g., /nkatab/→ [ʔin.katab], /kta.tab/→ [ʔik.ta.tab] ‘he registered’, and /stak.tab/→ [ʔis.tak.tab] ‘he received’. However, this consonant cannot remain in connected speech. As a result, it was targeted by deletion; e.g., /min/ ‘who’ /ʔana/ ‘I’→ connected speech → /minana/ ‘who am I?’ As discussed above, this behaviour is also found in colloquial Egyptian Arabic, as reported by Salem (2005). Likewise, a glottal stop in a preconsonantal position in disyllabic words undergoes deletion, whereas an empty position is filled with a copy of the stem vowel. When the deletion of a glottal stop occurs, a stem vowel is targeted by lengthening in order to fill a slot resulting from the deletion of this consonant (a glottal stop). Bakalla (1973) and Abu-Mansour (1987) attributed vowel lengthening in Meccan Arabic to Compensatory Lengthening (CL). They note that a glottal stop in a preconsonantal position is syncopated and a vowel lengthening process occurs alternatively to fill an empty slot, as in (1.6), (1.8), and (1.9). The glottal stop in the coda position in monosyllabic words undergoes syncopy as in (2.10); e.g., /raʔs/→ [ra:s] ‘head’. There is another case in which a glottal stop is glided when it is flanked by either a long vowel plus a short vowel or vice versa; e.g., a. /muru:ʔa/→ [muru:wa] ‘a sense of honour’ /ðiʔa:b/→ [ðija:b] ‘wolves’. According to Harrama (1993), the lengthening rule is applied to a glottal stop that is flanked by two non-identical short vowels, either /i/ plus /a/ or /u/ plus /a/, according to Shāhīn (1966) and Cadora (1989). A glide is geminated when it is stressed, as illustrated in rule (1.14) above; e.g., /miʔ̱ah/→ [mijah]→ [míjah]→ [míjjah] ‘a hundred’. According to Al-Mozainy (1981) and Harrama (1993), a final glottal stop in the coda position is targeted by the deletion, whereas a preceding glide undergoes a lengthening rule, as mentioned in (1.17) ; e.g., /ʃajʔ/→ [ʃajj] ‘thing’ and /ðˤawʔ/→ [ðˤaww] ‘light’. In the next section, I will demonstrate the types of vowels found in NA

1.4 Vowel Inventory in NA

Crosslinguistically, vowels are typically the most important element in a syllable. This is also true of Arabic dialects in general, including NA, in which only vowels can occupy the nucleus of a syllable. All scholars of Arabic, whether they focus on Classical Arabic or on various dialects, such as Al-ani (1970), Abu-Mansour (1978), McCarthy (1979a, 1979b), Abboud (1979), Selkirk (1981), Abu-salim(1982), Itô (1986, 1989), Jarrah (1993) Al-Mohanna (1994), Ingham (1994), Kiparsky (2003), Watson (2007), and others, unanimously agree that the nucleus is occupied only by a vowel in all syllable types in modern Arabic dialects, no matter whether these syllables are light, heavy, superheavy, or even extra-superheavy. This idea is addressed in section 2.5, but it is appropriate to first discuss the types of vowels in Najdi Arabic, which is the central focus of this section.

Abboud (1979), Al-Sweel (1987; 1990), Prochazka (1988), and Ingham (1994) observe that there are eight vowels in this dialect; three of them, /a/, /i/, and /u/, are short vowels, and there are also long counterparts, /i: /, /a: / and /u: /. In addition, there are also two long vowels that have no short counterparts, /o: / and /e:/. The total number of short and long monophthongs is eight. Note that the diphthongs such as /aj/ and /aw/ in MSA are realised as /e:/ and /o:/ in NA (Ingham 1994).

Table 1.5 Short and long vowels in NA (Abboud, 1979 & Ingham, 1994)

Short	Long
i	i:
a	a:
u	u:
-	e:
-	o:

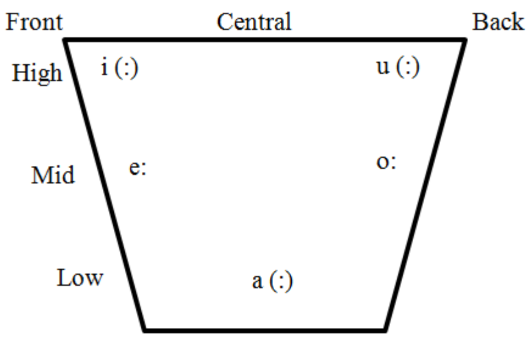


Figure 1.2 Vowel Chart of NA

As seen in table (1.5) and figure (1.2), the basic opposition between the vowels above is length. In fact, the mid monophthongs /o:/ and /e:/ are purely colloquial as in the words

/bayt/→ [be:t] and /lawn/→ [lo:n] 'colour'. Both monophthongs are also found in some loanwords like /ke:k/ ‘cake’ and /telefo:n/ ‘telephone’. There is a contrast between both vowels /i/ and /u/. Firstly, short vowels /i/ and /u/ are found in non-final open syllables, whereas the vowel /a/ occurs in closed syllables (Ingham 1994); e.g., [ki.tab] ‘he wrote’, [glu.bat] ‘she overturned’. Secondly, according to Al-Sweel (1990), Ingham (1994), McCarthy (1994), and Zawaydeh (1999), a low vowel /a/ is never changed to a high vowel [i] (vowel raising) when it is adjacent to any gutturals. Consider the following examples:

(1.18)

(I)

a./ħa.lam/→ [**ħa**.lam] /*[**ħi**.lam] ‘he dreamt’

b. /ʁa.lab/→ [**ʁa**.lab] /*[**ʁi**.lab] ‘he defeat’

c. /ha.zam/→[**ha**.zam] /*[**hi**.zam] ‘he defeated’

d. /ʕa.sˤar/→[**ʕa**.sˤar]/*[**ʕi**.sˤar] ‘he squashed’

e./χa.dam/→[χa.dam]/* [χi.dam] ‘he served’

II)

a. /ra.ħal/→[**ra**.ħal]/ *[**ri**.ħal] ‘he moved’

b. /sˤa.ʁar/→[**sˤa**.ʁar]/ *[**sˤi**.ʁar] ‘he became small’

c. /sa.har/→[**sa**.har]/ *[**si**.har] ‘he stayed up’

d. /qa.ʕad/→[**ga**.ʕad]/*[**gi**.ʕad] ‘he had a seat’

Third, the low vowel /a/ in a light open syllable does not undergo raising when it is preceded by sonorants [n, l, r, w], according to Al-Sweel (1990) and Ingham (1994).[9] Consider the following examples below:

(1.19)

a. /sa.raq/→ [**sa**.rag]/ *[si.rag] ‘he stole’

b. /tˤa.lab/→[**tˤa**.lab]/*[**tˤi**.lab] ‘he requested’

c. /ma.naʕ/→[**ma**.naʕ]/*[**mi**.naʕ] ‘he prevented’

d. /ba.na/→[**ba**.na]/*[**bi**.na] ‘he built’

e. /ga.nasˤ/→[**ga**.nasˤ]/*[**gi**.nasˤ] ‘he hunted’

[9] Sakarna (2005) reports, according to Irsheid (1984:30), that rising a low vowel /a/ is blocked in modern Jordanian dialects by preceding and following gutturals like /χ/, /ʁ/, /ħ/, /ʕ/, and /h/. Also, it is blocked by the following alveolar sonorants (l, r, n):a. /ba.la/ ‘disease’

f. /ʤa.wab/→[**ʤa**.wab]/* [**ʤi**.wab] 'an answer or a letter'

However, a low vowel /a/ is targeted by the raising process, as shown in the examples below:

(1.20)

a. /**qa**.tal/→[**gi**.tal] 'he killed'
b. /**la**.qa/→[**li**ga] 'he found'
c. /**ra**.ma/→[**ri**.ma] 'he shot a gun'
d. /**wa**.zan/→[**wi**zan] ' he measured weight'

As shown in the examples in (1.20), a low vowel /a/ is not immune to raising since it is neither adjacent to gutturals nor adjacent to the sonorants [l, n, r, w].

According to Abboud (1979), Al-Mozainy (1981), Al-Sweel (1987; 1990), Prochazka (1988), and Ingham (1994), the emphaticization of /r/ simply co-occurs with the vowel /u/. To demonstrate this point, the segment /r/ is emphaticized when it comes before or after a high back vowel /u/, either short or long. Consider the following examples:

(1.21)

I.

a. /grˤu:ʃ/ 'coins'

b. /ħrˤu:b/ 'men from Harb tribe'

II.

a. /murˤrˤ/ 'bitter'
b. /burˤrˤ/ 'a type of wheat'

A long vowel /aa/ in a hollow verb results from the deletion of intervocalic glides /j/ and /w/ found in the underlying pattern /CaCaC/, according to Harrama (1993).[10] Consider the following examples below:

[10] Harrama (1993: 62-63) defines a hollow verb as "those whose second root is a glide, provided that such a glide is not geminated or preceded by a long vowel". He sheds light on a long vowel /aa/ in Al-Jabal dialect in Libya that is created by the deletion of a medial glide which is not preceded by another glide (intervocalic glide). I observe that this behaviour is also found in Najdi Arabic in a hollow verb [ga:l] 'he

(1.22)

a. /ga**w**al/→ [ga:l] 'he said'

b. /ba**j**aʕ/→ [ba:ʕ] 'he sold'

c. /χa**w**af/→ [χa:f] 'he was afraid'

d. /tˤa**j**ar/→ [tˤa:r] 'it flew'

e. /na**w**am/→ [na:m] 'he slept'

f. /sˤa**j**ad/→ [sˤa:d] 'he hunted'

g. /ma**j**al/ → [ma:l] 'he leaned'

To conclude, the entire inventory of vowels in NA was overviewed in this section. The diphthongs /aj/ and /aw/ in Classical Arabic were realised as monophthongs /e:/ and /o:/ in this dialect; e.g., /bajt/→ [be:t] 'house' and /lawn/→ [lo:n] 'colour'. These monophthongs were also found in some loanwords like /keek/ 'cake' and /telefoon/ 'telephone', as mentioned above. The contrast between the short vowels /i/ and /a/ was illustrated in this section. Firstly, the low vowel /a/ was shown as the one found in closed syllables, unlike /i/ and /u/. Secondly, the low vowel /a/ is preceded by gutturals or the sonorants [l, n, r, w] in open syllables. Third, it follows gutturals, compared to the sonorants [l, n, r, w]. However, I demonstrated a case in which a low vowel /a/ undergoes the raising process; e.g., /**qa**.tal/→[**qi**.tal] 'he killed', /**la**.qa/→[**li**ga] 'he found', /**ra**.ma/→[**ri**.ma] 'he shot a gun', /**wa**.zan/→[**wi**zan] 'he measured weight'. There are two reasons for raising a low vowel /a/; firstly, this vowel is not flanked by gutturals in open syllables. Secondly, it is not followed by the sonorants /n/, /l/, /r/, and /w/ in open syllables. Abboud (1979), Al-Mozainy (1981), Al-Sweel (1987; 1990), Prochazka (1988), and Ingham (1994), agree that the emphaticization of /r/ occurs when this consonant is adjacent to vowel /u/ ; e.g., /grˤu:ʃ/ 'coins', a. /murˤrˤ/ 'bitter'. The long vowel /a:/ in hollow verbs results from the deletion of intervocalic glides /w/ and /j/ in words like /ga**w**al/→ [ga:l] 'he said' and /ba**j**aʕ/→ [ba:ʕ] 'he sold'.

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said' , for example, in which medial long vowel results from the deletion of the intervocalic glide /w/; e.g.,/gawal/→ [ga:l].

1.5 Data Collection

My investigation into the syllable structures and phonological phenomena of NA was based primarily on the extant literature, both of works specific to NA, as well as to Arabic varieties more generally, in addition to the theoretical literature on syllables, syllable structures and syllable typologies. My analyses primarily focused on data taken from articles, essays, theses, and journals, reinforced by my own judgments as a native speaker of NA. In addition, I interviewed 15 male native speakers of Najdi Arabic who are between the age of twenty and thirty five years old.[11] Some words were transcribed in order to give some examples of major syllable structure processes in NA such as metathesis, epenthesis, vowel shortening, and syncope.[12] These participants are living in Riyadh, Saudi Arabia.[13]

1.6 Overview of the dissertation

The remaining chapters in this dissertation are organised as follows: the second chapter is allocated to addressing the role of the syllable in the overall theory of grammar by tackling the empirical piece of evidence; i.e., the syllable and suprasegmental phonology. This chapter also indicates the internal structure of the syllable, sonority hierarchy and the syllable, and the syllable in Arabic. The last part in this chapter discusses Optimality Theory (OT), as a framework, along with syllable structure processes that can be analysed by this framework such as insertion (epenthesis), syncope, vowel shortening, and CV-metathesis.

The third chapter deals with major syllable structure processes found in some modern Arabic dialects including metathesis, epenthesis, vowel shortening, and syncope. Accordingly, the first section introduces the content of this chapter, and the second section discusses the previous studies of epenthesis in modern Arabic dialects. The third

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[11] I adhered to the way that Rakhieh (2009) collected his data and I did not focus on interviewing my relatives who are older than 35 years old because they used to live in other cities in Saudi Arabia for a long time as soldiers. Most of them used to live in eastern province while others used to live in western province.

[12] The whole speech was not transcribed since connected speech was not the main focus in this thesis.

[13] I chose those native speakers who live in Riyadh rather than those who live in the UK due to code-switching and communication with speakers of other modern Arabic dialects in the UK. I also excluded NA speakers who live in the Western Province in Saudi Arabia (Hijaz) since they are affected by Urban Hijazi speakers, according to Alessa (2008). Most of them are my friends while the others are my relatives.

section deals with previous studies of vowel shortening in some modern Arabic dialects, while the fourth section tackles metathesis and syncope in some modern Arabic dialects.

NA syllable structure and OT undergo investigation in the fourth chapter. This chapter aims to address the types of syllable structures in this dialect along with the types of onsets and codas, i.e. simple and complex. The relation between the syllable weight and stress parameters in NA are taken into consideration in this chapter, i.e. light vs. heavy syllables. Final and non-final superheavy syllables of the forms CVVC and CVCC undergo the analysis of OT before the section of the unified set of OT constraints which is allocated to investigate syllable structure types in NA.

The fifth chapter is devoted to understanding how the phonological processes including metathesis, epenthesis, vowel shortening, and syncope have an impact on NA syllable structure through OT analyses. In other words, this chapter is allocated to dealing with phonological processes in this dialect through understanding the motivators for these processes. It does so by utilizing OT analyses. Furthermore, this chapter includes a comparison of CV metathesis, vowel epenthesis, and syncope in NA and UHA in light of OT.

Finally, the sixth chapter presents the fundamental aims and main questions that are addressed in this thesis. Also, all chapters in this thesis are summarized in this chapter along with my findings.

Chapter 2. Theoretical Background

2.1 Introduction

This chapter aims to introduce some theoretical background knowledge about the syllable since, along with the analytical framework of OT, it is the central focus of this thesis. Before discussing issues related to the syllable and related processes within OT, it is necessary to begin with the general theoretical background related to syllables and then narrow down to the central discussion. Firstly, the role of the syllable in the theory of grammar will represent the initial stage in this chapter: the syllable and stress assignment as the piece of evidence that reveals the importance of the syllable in the theory of grammar will be summarized at the beginning of this chapter. The next section will be specific to the internal structure of the syllable. This section will deal with constituents in the structure of the syllable in order to determine which constituent is obligatory. Furthermore, in this section, the mora model will be explained, as an adopted syllable theory. The relation between the syllable and sonority hierarchy will then be demonstrated in section 2.4. After giving some information about the syllable in general, in section 2.5, the syllable types in Standard Arabic (SA) will be illustrated in detail in order to show which syllable types in SA are accommodated by modern Arabic dialects and which syllable types in modern Arabic dialects are absent in SA. This section is followed by two subsections which address syllable weight and extrametricality in Arabic and non-final superheavy syllables and semisyllables in Arabic. In the section on syllable weight and extrametricality in Arabic, the final consonants in CVC, CVVC, and CVCC will be differentiated in terms of extrametricality and extrasyllabicity by adopting the moraic model. In other words, the final consonant in CVC syllable will be shown to be extrametrical and the final consonant in CVCC and CVVC will be shown as an extrasyllabic. In the next subsection, I will show the different treatment of the final consonant in CVCC and CVVC in the non-final position. In short, the last consonant in non-final CVCC and CVVC, as a semisyllable, is treated either by vowel epenthesis or mora sharing. Some dialects permit vowel epenthesis before a semisyllable (VC-dialects) and others after this consonant (CV-dialects), whereas other dialects (C-dialects) allow mora sharing rather than vowel epenthesis. This behaviour will be illustrated in section 2.5.2. The final section will discuss OT as an analytical framework and the syllable structure processes that are involved in OT analysis such as insertion (epenthesis) syncope, vowel shortening, and CV-metathesis.

2.2 The phonological role of the syllable in an overall theory of grammar

I recognise the importance of the syllable (as argued by Hooper (1972), Vennemann (1972), Kahn (1976) McCarthy (1979a, 1979b), Selkirk (1982), Clements and Keyser (1983), and Blevins (1995)) and as such I will explore the structure of the syllable in NA and the usefulness of the syllable in characterising various phonological processes in the language. The phonological role of the syllable in the theory of grammar is borne out by three pieces of evidence. First of all, the phonotactic patterns of a language can be determined by a syllable. For example, according to Kahn (1976), the hypothetical *atktin* cannot be recognised as an impossible word in English without direct reference to the syllable. The sequences *kt* and *tk* are neither permitted word-initially nor word-finally. However, they are found in the word-medial positions in some words like *Atkins* and *Cactus*. For this reason, *atktin* is not considered to be a possible word in English since the consequences *kt* and *tk* do not occur word-initially and word-finally. Secondly, rules of segmental phonology, such as rules of nasalisation, assimilation, vowel lengthening, aspiration, and affrication, are accounted for with reference to a syllable. For instance, Broselow (1979) supports the claim that a syllable can account for the rules of segmental phonology; hence, she states that phryngealisation in Cairene Arabic is accounted for within a syllable rather than by using other approaches. Moreover, Kahn (1976) states that aspiration in English is determined by a syllable; hence, obstruents in English are aspirated in the syllable-initial position. Finally, the syllable is regarded as a natural domain for suprasegmental phenomena like stress and tone. This evidence will be illustrated in detail in the next subsection.

2.2.1 The Syllable and Stress Assignment

McCarthy (1979a, 1979b) states that stress assignment completely relies on a syllable's weight and position. He notes that stress assignment is located by mora which is merely an abstract property of the syllable; i.e., he states that a mora can determine syllable weight. According to him, the syllable weight (whether light, heavy, or superheavy) which is, in turn, associated with syllable structure (whether open with short or long vowel or closed), and the syllable position (whether ultimate, penultimate, or antepenultimate) can determine stress assignment. Al-ani (1970) indicates the parameters of stress assignment in Classical Arabic which take syllable weight and position into consideration, as in (2.1) below:

(2.1) Stress Parameters in Classical Arabic (Al-ani 1970)

(I) Primary stress falls on the antepenultimate syllable when a word has only light syllables:

a. ˈka.ta.ba. ‘he wrote’

b. ˈda.ra.sa. ‘he studied’

c. sa.ˈħa.ba.hu. ‘he pulled him’

d. da.ˈra.ba.ni ‘he hit me’

(II) Stress falls on heavy syllables. Therefore, if a word has only one heavy syllable, then it is assigned primary stress:

a. ta. ˈsa: .fa. ħu. ‘they shook hands’

b. mu.ˈsa:. ʕi.du.hu. ‘his helper’

c. ju.ˈχaw.wi.fu.ni. ‘he is frightening me’

d. ta.ˈdaħ.ra.ja ‘he rolled’

(III) The heavy penultimate syllable is assigned primary stress if a word has more than one heavy syllable.

a. ra.ʔii.su.ˈhun.na. ‘their (fem) chief’

b. mu.ˈsaa.fir. ‘a traveller’

c. ʔiħ.ˈmar.ra ‘he turned red’

d. ʔis.taʕ.ma.ˈlat.hum. ‘she used them’

Stress parameters in (2.1) reveal the fact that syllable recognition is essential in stress assignment. The syllable weight and /or position can determine where stress falls. Illustrating this point, some of the stress parameters above rely on the position of the syllable for example (2.1-I, III). In (2.1-I), the antepenultimate syllable receives stress if the penultimate and ultimate syllables are light, but the heavy antepenultimate receives no primary stress if the penultimate syllable is heavy. In (2.1-III), a heavy syllable receives stress before the ultimate syllable. In (2.1-II), primary stress falls on the heavy syllable regardless of the position of this syllable.

To conclude, this section demonstrated the role that the syllable plays in the theory of grammar by considering the example of syllable and stress assignment (supra-segmental phonology).With regard to supra-segmental phonology, stress assignment depends on a syllable's weight and position, according to Al-ani (1970) and McCarthy (1979a, 1979b). For instance, the stress parameters in Classical Arabic are characterised by reference to a syllable's weight and /or position (Al-ani 1970).

2.3 The Internal Structure of the Syllable

Many scholars state that the syllable is traditionally viewed as a unit that consists of an optional onset followed by an obligatory rhyme; this rhyme can be either simple, which is employed by a single segmental slot, as [+syllabic], or complex, which is employed by two slots; the additional segment can be either vocalic or non-vocalic. To clarify this, the obligatory part in the rhyme is well-known as a nucleus or peak which is [+syllabic], whereas other segments are [-syllabic]. This statement is supported by Blevins (1995) and Angoujard (1990); Blevins (1995:207) defines the syllable as "the phonological unit which organizes segmental melodies in terms of sonority." Angoujard (1990:26-29) states that the principles involved in the theory of the syllable are as in (2.2):

(2.2)

Principles of the syllable (Angoujard 1990:26-29):

a. Each syllable contains one and only one sonority peak.
b. Each syllable contains *n* segmental slots.
c. The segmental slots have a predetermined hierarchic interrelation.

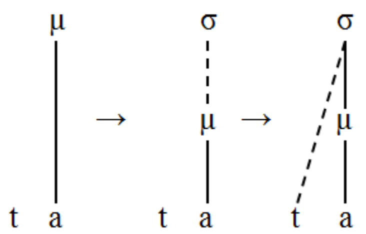
According to these principles, a peak which is usually a vowel or a syllabic consonant is obligatory in the syllable. According to Angoujard (1990), these principles assume a maximal limit for the number of segments. Finally, a hierarchical relationship governs the arrangement of segments; i.e., the hierarchical relation is the sonority scale which represents the sonority values of segments. This idea will be illustrated in subsection 2.4.

The adopted syllable theory in this thesis is the mora model which is introduced by Hyman (1985), McCarthy & Prince (1986, 1990), Hayes (1989), and Broselow (1995). They agree that this theory is considered the most important and influential syllable theory. Broselow (1995:188) states that the notion of mora, or weight unit, is recognised as an old concept in almost every school of linguistics. The mora has a twofold role in the theory of mora proposed by Hyman (1985) and McCarthy and Prince (1986). The first role is that the mora is considered a unit in the syllable's weight that discriminates between light and heavy syllables. Light syllables are monomoraic, but heavy syllables are bimoraic. Farwaneh (1995:5) states that mora plays a dual function; the first function is to determine the weight of the syllable. The second function is that a mora plays a role as skeletal position which displays the position of segments in the syllabic structure. However, with respect to Farwaneh's (1995) finding, an onset in Arabic can have a skeletal point even though it is not moraic. Moras only play a role in the weight of the syllable, focusing on those parts of the syllable that contribute to weight, i.e. vowels and some codas.
Based on moraic theory (Hyman 1985; Hayes 1989, 1995, Broselow1995), X-slots in the nucleus are substituted with moras. In the coda, X-slots are replaced by moras in languages in which CVC is recognised as a heavy syllable, whereas a coda is directly linked to a syllable node in languages in which CVC is a light syllable, according to Archangeli (1989), Hayes (1989), and Tranel (1991). CV is universally treated as a light syllable since it represents one mora, and CVV is treated as a heavy syllable in most languages because it is bimoraic (it has two moras). However, a CVC syllable is treated differently, compared to CV and CVV; it is considered to be heavy in English and Arabic while other languages, like Lardil, treat it as a light syllable (Wilkinson 1988). "A language-specific rule should state how a certain language treats different types of syllables", Rakhieh argues (2009:62). Hayes (1989) proposed weight-by-position rule which says a consonant in the coda should be moraic. Therefore, in the CVC syllable, a rhyme may be assigned with either one or two moras, depending on the language rules.

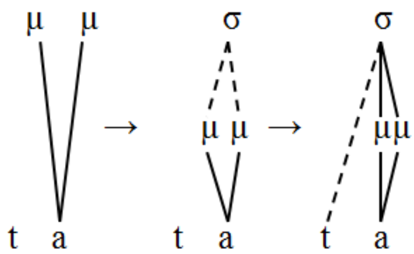
The idea in moraic theory that onsets cannot be moraic does not apply cross-linguistically. Some languages argued to have moraic onsets, including Pirahã (Arabela), Karo, Aranda, Truckese, Pattani Malay, Marshallese, and Bellonese (Topintzi 2006). Onsets in these languages are taken into consideration in terms of identifying stress. Rakhieh (2009) states that some phonologists assume that consonants in the onset that share a mora with a vowel have an impact on syllable weight. However, Tonpintzi (2006) mentions that a moraic onset is directly linked to a syllable node and does not share a mora with a vowel. In the case of Arabic, onsets are weightless and are not considered in stress parameters, whereas the nucleui and codas contribute to the weight of the syllable as well as stress parameters, as discussed in subsection 2.2.1.

Long segments are represented in two ways: long vowels are assigned two moras, but geminate consonants are linked to one mora and to the syllable node of the following syllable, because geminate consonants are employed as a coda of the preceding consonant and an onset of the following syllable. The representations below show the assignment of moras plus the syllabification of CV, CVV, VCCV, and CVC. Also, the assignment of moras helps to differentiate between a light and heavy CVC syllable.

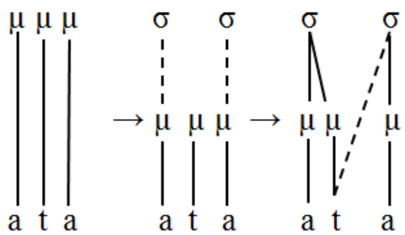
(2.3) CV representation (Hayes 1995:52)



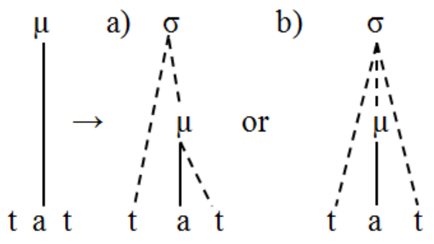
(2.4) CVV representation (Hayes 1995:52)



(2.5) VCCV representation (Hayes 1995:52)

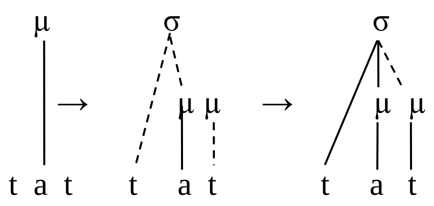


(2.6) CVC "light" representation (Hayes 1995:52)



The representations in (2.6) are different in terms of mora sharing; hence, in (2.6.a), mora sharing is permitted in the language. The coda is weightless in (2.6.b). CVC, as a heavy syllable, is found in languages that apply the "weight-by-position rule". Consider the following representation.

(2.7) CVC "heavy" representation "languages which apply the weight-by-position rule." Rakhieh (2009:64)



To sum up, Rakhieh (2009: 64) stated that there were five advantages of using the moraic model over other syllable models:

(2.8) Advantages of using the moraic model (Rakhieh 2009:64)

a. Moras are better integrated into the prosodic hierarchy.[14]

b. The model expresses the weight-irrelevance of the onset.

c. It expresses the variable nature of coda-weight.

d. It offers an account of short vowels vs. long vowels and singletons vs. geminates.

e. It offers a way of expressing light, heavy, and superheavy syllables.[15]

[14] Selkirk (1980a) and Nespor & Vogel (1986) define the prosodic hierarchy as a theory in which words and phrases may be parsed into prosodic constituents that form the domains of rule application. This hierarchy is shown in (3.35).

After illustrating the internal structure of the syllable, the question that should be addressed is: Why is the nucleus the only obligatory constituent of the syllable? According to Al-Mohanna (1994), some phonologists agree that the rhyme branches into the obligatory nucleus node and the optional coda node. The nucleus is the most important constituent of the syllable, for two reasons. Firstly, it is the only unit which bears the stress or tone. The stress or tone will be dislocated when deleting the nucleus while the stress or tone will not be affected by the deletion of a consonant, i.e., a coda or an onset (Kenstowicz 1994). The second reason is related to what Clements and Keyser (1983) propose regarding the types of core syllables, as in (2.9):

(2.9)

a. CV

b. V

c. CVC

d. VC

(Clements and Keyser 1983:28)

The types of core syllables indicate the fact that the nucleus (the vocalic segment) is the most important element in the syllable. It exists in all types of core syllable in (2.9). This means that the existence of the syllable depends on the availability of a nucleus. This leads to the most striking piece of evidence that the nucleus is the most important constituent of the syllable. Consider the following representations from Bedouin Hijazi Arabic (Al-Mozainy 1981) (UR stands for underlying representation, and SR stands for surface representation):

(2.10)

a. /ku.ˈra:ʕ/ (UR) → [kra:ʕ] (SR) ‘leg’

b. /baħr/ (UR) → [ba.ħ**a**r] (SR) ‘sea’

---

[15] Scholars including Aoun (1979, Selkirk (1981), Kenstowicz (1994), Hayes (1995), Kager (1995b), and Kiparsky (2003) agree that superheavy syllables in Arabic are heavy syllables of the form CVC or CVV plus degenerate syllables (extrasyllabic consonants). Bamakhramah (2009) states that non-final superjeavy syllables are heavy syllables of the form CVC or CVV plus a moraic consonant that is not affiliated to the syllable node (semisyllable).

The disyllabic form in (2.10.a) becomes monosyllabic due to the deletion of an unstressed short vowel in a non-final light syllable. On the other hand, a mono-syllabic form in (2.10.b) becomes disyllabic because the final consonant cluster that violates the SSP is broken up by vowel epenthesis; i.e. /CVCC/→ [CV.C**V**C].

To conclude, the internal structure of the syllable was demonstrated in this section along with the mora model. The syllable consists of three constituents: onset, nucleus, and coda. The nucleus represents the peak which owns the highest sonority value compared to onset and coda. The mora model was shown as a syllable theory that can distinguish between light and heavy syllables depending on the number of moras in the syllable. This theory also revealed the fact that onsets are nonmoraic (weightless). The question related to the importance of the rhyme in the syllable was answered by Al-Mohanna (1994) who states that the nucleus bears the stress and the tone, and that the deletion of this constituent leads to the disappearance of the syllable and importantly to the shifting of stress and tone. The second answer was given by Clements and Keyser (1983) who list core syllables in which the nucleus is obligatory compared to onset and coda. In other words, the insertion of a vowel results in a newly-created syllable and the deletion of a vowel results in the deletion of the entire syllable. This was demonstrated with reference to Bedouin Hijazi Arabic. The relation between the syllable and sonority hierarchy will be illustrated in the next section.

2.4 The syllable and Sonority Hierarchy

The idea that segments in syllables are gathered into different groups depending on their hierarchic interrelations is considered to be a well-known fact in the theory of syllable structure (Rakhieh 2009). This hierarchic interrelation is called *Sonority Hierarchy* or *Sonority Scale* among scholars like Selkirk (1984), Clements (1990), Rice (1992; 2006), and Parker (2002; 2008) among others.

In general, sonority is deemed an acoustic property of sounds (Rakhieh 2009). However, with respect to Rakhieh (2009), an acoustic property of sounds does not tell much about sonority. Therefore, I refer to Ladefoged & Johnson (2011:245) who the concept, saying**“**sonority of a sound is its loudness relative to that of other sounds with the same length, stress, and pitch**”**.

Hooper (1976), Kiparsky (1979), Broselow (1979), Selkirk (1984), Clements (1990), and Butt (1992) have presented their studies which aim to achieve a universal sonority hierarchy. The presentation of universal sonority scale is shown in (2.11), in which obstruents are the least sonorous and vowels are the most sonorous.

(2.11) Universal Sonority Scale

5 Vowels

Low vowels

Mid vowels

High vowels

4 Glides

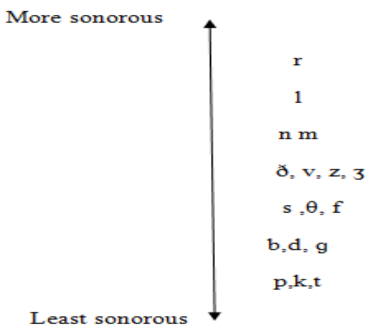
3 Liquids

2 Nasals

1 Obstruents

According to Clements (1990), stops and fricatives form a single class in relation to the sonority scale. On the other hand, Selkirk (1984), Katamba (1989), Butt (1992), and Teifour (1997) argue that voiced obstruents are more sonorous than voiceless ones, as shown in (2.12):

(2.12)



It is clear from the sonority scale above that affricates are not included, even though they are considered to be members of the obstruent family. In fact, there is an argument that affricates are a part of obstruents in the sonority scale, i.e. "affricates cross-linguistically pattern with plosives and fricatives". (Parker 2008:58). Accordingly, this type of obstruent is ignored in many treatments of sonority: are affricates two phonemic units or one and should they belong to stops or fricatives or both or with neither (Escure, 1977; Hankamer & Aissen 1974; Lavoie, 2000)? These questions were addressed by Parker (2008) who mentions that this type of obstruent is found in most scales being ranked between plosives and fricatives. Based on the universal sonority scale in (2.11) and the sonority scales that rank affricates in the middle, Parker (2008) introduces the comprehensive sonority scale which ranks affricates higher than stops and lower than fricatives:

(2.13) The comprehensive Sonority Scale

Most sonorous

Low vowels

Mid vowels

High vowels

Glides

Liquids

Nasals

Voiced fricatives

Voiced affricates

Voiced stops

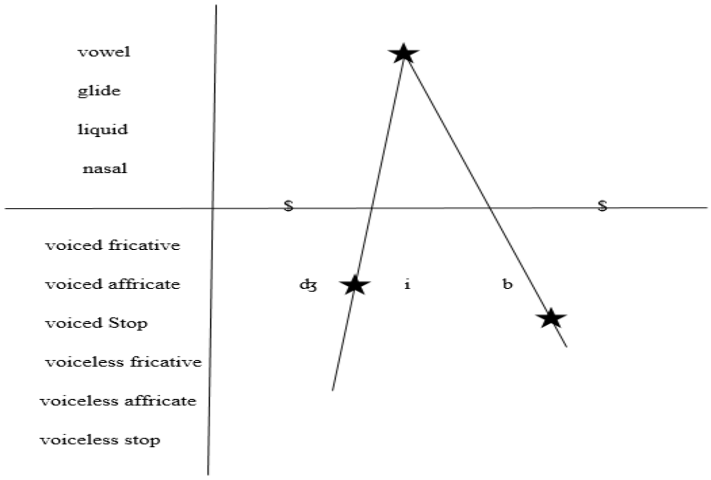
Voiceless fricatives

Voiceless affricates

Least sonorous Voiceless stops

The peak sonority in syllables represents the most sonorous segment which is either flanked by marginal segments, like onsets and codas. Additionally, it might be followed or also be preceded by these marginal segments (Rakhieh 2009). Sonority takes the shape of a curve or a mountain, ascending from the onset towards the peak and descending towards the coda. Consider the following representation of the imperative in NA [ʤib] ‘bring!’:

(2.14)



The representation (2.14) obeys the Sonority Sequencing Principle (SSP) (Hooper 1976; Kiparsky 1979; Steriade 1982; Selkirk 1982; Clements 1990; Parker 2002) since the sonority takes the shape of a mountain.

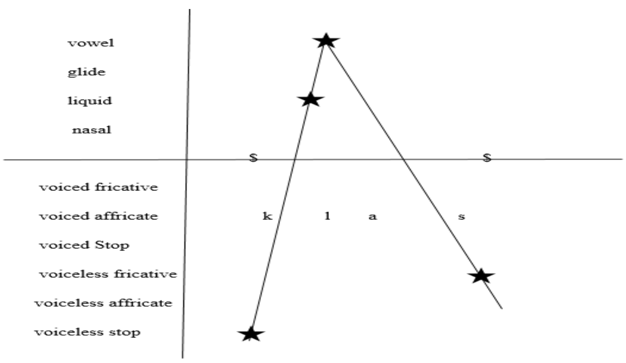
(2.15) Sonority Sequencing Principle (SSP) (Parker 2002:07):

a. In every syllable there is exactly one peak of sonority, contained in the nucleus.

b. Syllable margins exhibit a unidirectional sonority slope, rising toward the nucleus.

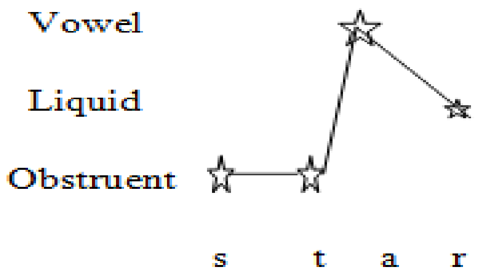
In terms of complex onsets and codas, the peripheral segments should be less sonorous than consonants closer to a nucleus. Consider the following representation of the word *class* in English:

(2.16)



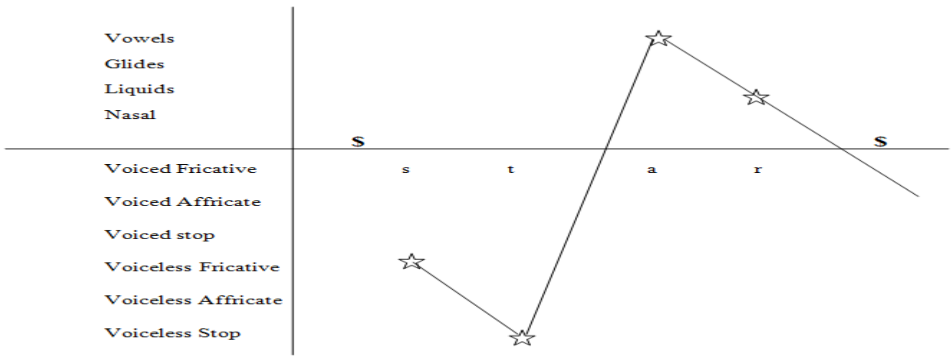
Unlike an initial kl- cluster, s-initial onset clusters in English leads to an argument about the manners of sonority violations that these clusters constitute. By adopting the universal sonority scale in (2.11), we may believe that initial st- clusters, for example, constitute Plateau Sonority since obstruents are equal in sonority. Consider the following representation of the word *star* in English using the universal sonority scale in (2.11):

(2.17)



The universal sonority scale in (2.11) does not differentate between fricatives and plosives in terms of their sonority values. By adopting the comprehensive sonority scale in (2.13), we can possibly notice the different sonority value of both obstruents which consequently form reverse sonority. This is because voiceless fricatives are more sonorous than voiceless stops as shown in the representation of the same word below:[16]

(2.18)



Some consonant clusters are not allowed in certain languages, even though they obey SSP. For instance, initial consonant clusters, like /pn-/ and /ps-/, are not permitted in English, whereas Roca and Johnson (1999) state that these clusters are pronounceable in Greek in words like *psycholgia* 'psychology' and *pnefmonia* 'pneumonia'. Selkirk

[16] Even though the initial /st-/ cluster constitute reverse sonority, it is permitted in English. Likewise, the word-initial cluster /sk-/ which constitutes reverse sonority is permitted in English. These word-initial clusters are not avoided by vowel epenthesis in English. This shows that sonority sequencing principle is not strictly maintained in English.

(1984) and Clements (1990) among others take these phenomena into consideration by proposing that *Minimal Sonority Distance* that can account for them:

(2.19) Minimal Sonority Distance (MSD) (Selkirk 1984 and Clements 1990):

The member of a cluster must be *d* distance apart on the sonority scale.

According to the definition of MSD above, the sonority distance between the members of the initial consonant clusters /pn-/ and /ps-/ is less than two intervals as shown in the scale (2.20); therefore, they are not permitted in English.

(2.20)

Based on the scale in (2.20), Zec (2006) presents a table below that shows the MSD range of values:

(2.21) MSD Range of Values

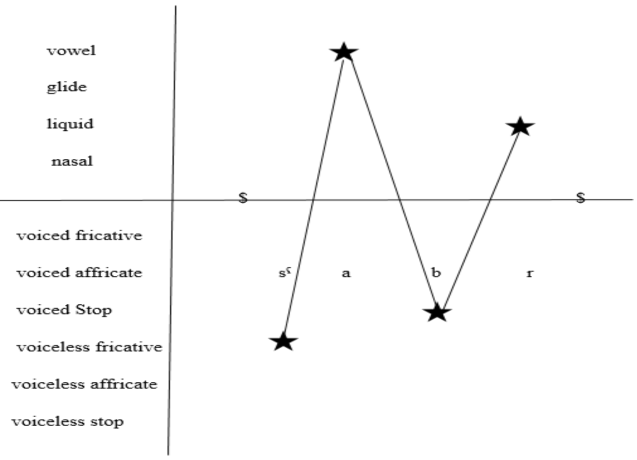
MSD 0	OO, NN, LL, GG
MSD 1	ON,NL,LG
MSD 2	OL, NG
MSD 3	OG

According to the scale in (2.20) and the MSD range of values in (2.21), in English, the sonority distance between the members of a /ps-/ cluster is zero interval since both members are obstruents, while the sonority distance between the members of a /pn-/ cluster is one interval because the first member is an obstruent and the second member is a nasal.

In Spanish, /pn-/ and /ml-/, as initial consonant clusters, are not permitted, whereas /pr-/ and /pl-/ are possible consonant clusters. With reference to the MSD scale in (2.20), /p/ and /n/ are separated by one interval as well as the sonority distance between /m/ and /l/, while the sonority distance between the members of /p/ and /r/ and between /p/ and /l/ is two intervals. Consonant clusters with 2-MSD are permitted, whereas those with 1-MSD are disallowed in Spanish.

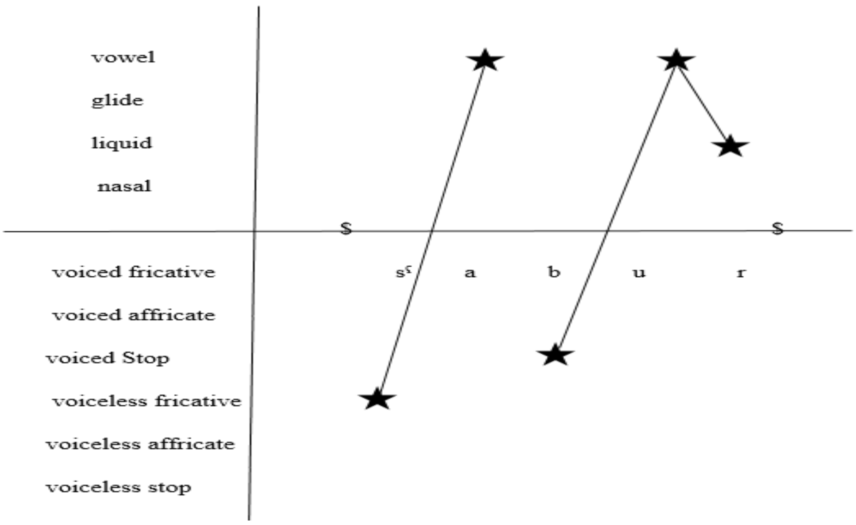
The sonority violation in the coda position can be detected by using Parker's sonority scale in (2.13). Consider the following representation of the input /sˤabr/ 'patience' in NA:

(2.22)



The representation in (2.22) shows Reverse Sonority in the coda position. This violation is avoided in NA by vowel epenthesis as shown in the representation below:

(2.23)



The epenthetic vowel [u] is inserted to split the members of word-final clusters in order to obey SSP, resulting in a disyllabic word. This behaviour is discussed in details in subsection 5.3.2.1.1.

To conclude, this section highlighted the relation between the syllable and sonority hierarchy. Firstly, I presented the universal sonority scale that has been adopted by Hooper (1976), Kiparsky (1979), Broselow (1979), Selkirk (1984), Clements (1990), and Butt (1992). Based on this scale, with respect to the scholars above, I referred to Parker's (2008) comprehensive sonority scale that can distinguish between obstruents, since the universal sonority scale in (2.11) does not cover the sonority relation between these types of consonants.The sonority in NA will be tested using Parker's sonority scale in chapters 4 and 5. Secondly, I illustrated how the peak is the most sonorous constituent in the syllable which might be flanked by two constituents that are less sonorous (onset and coda) or that precedes an onset or is followed by a coda. Furthermore, the manners of the SSP violations plateau and reverse sonority were demonstrated by adopting Parker's (2008) scale. For example, by using the comprehensive sonority scale (2.13), I showed that the initial /st-/ cluster in the word *star* constitutes plateau sonority since the members of this cluster are obstruents, but this cluster constitutes reverse sonority through Parker's scale because the second member of this cluster, as a plosive, is less sonorous that the first one, as a fricative. At the end of this section, I shed light on some consonant clusters that are not permitted in some languages, even though they obey SSP. I showed how this is attributed to the MSD (Minimal Sonority Distance).The next section will be specific to the syllable in Arabic in order to see the syllable types in Standard Arabic (SA) and which syllable types in SA are accommodated by modern Arabic dialects and which syllables are presented by modern Arabic dialects and are absent in SA.

2.5 The syllable in Arabic

There are three considerations which should generally be taken into account when talking about syllables in SA. Firstly, there is no onsetless syllable which means that onset is obligatory. Second, complex onsets are not permitted, even though onset is required. Finally, codas, either single or complex, are allowed in Arabic. The three criteria for the syllable in MSA are satisfied by the syllables shown in (2.24):

(2.24) SA syllable types

CV	/qa.ra.ʔa/	'he read'
CVC	/<u>kal</u>.la.ma.na/	'he talked to us'

CVCC	/qird/	‘monkey’
CVV	/tˤa:.ʔir/	‘bird’
CVVC	/sa:m/	‘poisonous’
CVVCC	/ħa:d:/	‘sharp’

As shown in (2.24), there are three observations regarding syllable types in SA. Firstly, syllables that lack onsets are prohibited, which shows that single onsets are obligatory in the syllable as well as a nucleus, while codas are optional since they are found in some syllable types and absent in others like CV and CVV. In fact, there are some modern Arabic dialects that allow complex onsets such as Moroccan (Boudlal 2001), Ma’ani (Rakhieh 2009), Najdi (Abboud 1979; Prochazka 1988; Ingham 1994) Bedouin Hijazi Arabic (Al-Mozainy 1981), Rafidah (Prochazka 1988; Kiparsky 2003) Bani-Hassan (Irshied 1984), and Abadi Arabic (Sakarna 1999), whereas these onsets are prohibited in other dialects such as Cairene (Broselow 1979), Urban Hijazi Arabic (UHA) (Al-Mohann 1998) and Al-Hassa Arabic (Aljumah 2008). Complex codas are found in some modern Arabic dialects such as Lebanese (Abdul-Karim 1980), Morocan (Boudlal 2001), Ma’ani (Rakhieh 2009), Najdi (Abboud 1979; Prochazka 1988; Ingham 1994), Bedouin Hijazi Arabic (Al-Mozainy 1981), Rafidah (Prochazka 1988; Kiparsky 2003), Urban Hijazi Arabic (Al-Mohanna 1998), and Cairene (Broselow 1979), while some modern Arabic dialects do not tolerate final consonant clusters like Baghdad Christian Arabic (Abū-Haidar 1991) and some Palestinian dialects (Abu-Salim 1982). It is clear that the range of syllable types in SA are accommodated by most modern Arabic dialects while other syllable types are added by some modern Arabic dialects. This shows that some dialects tolerate complex onsets which result from the deletion of the underlying high short vowel in an unstressed open syllable.[17] Consider the examples from Bedouin Hijazi Arabic in (2.25) below:

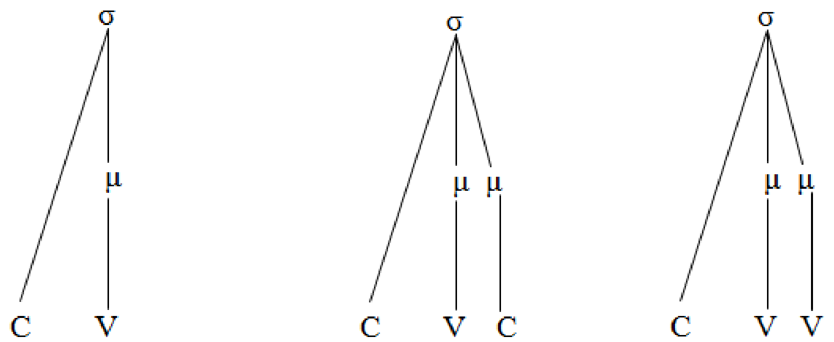
(2.25)	Input	Output	Glossary
	/t**u**.ra:b/	[tra:b]	‘dust’
	/ʤ**i**.ba:l/	[ʤba:l]	‘mountins’

[17] This behaviour will be discussed in detail in chapters 3, 4, and 5.

2.5.1 Syllable Weight and Consonant Extrametricality in Arabic

Arabic is a quantity-sensitive language that can differentiate between syllables in terms of their weight. CVC and CVV are heavy syllables since they have two moras (bimoraic), whereas CV is light because it assigns one mora (monomoraic).

(2.26) a. Light b. Heavy



McCarthy (1979b) proposed that the weight of the CVC syllable depends on its position in a given word. This is demonstrated by the fact that CVC syllable is heavy in non-final positions and light in final position due to the fact that the final CVC is unstressed and the last consonant of this syllable is deemed *extrametrical*; i.e. it is not moraic. For instance, Hung asserts that the CVC syllable in all modern Arabic dialects is heavy in non-final position only. Alber (2005) and Al-Jarrah (2011) agree that stress in quantity-sensitive languages is received by heavy syllables, but the CVC syllable in the final position fails to attract stress since the last consonant is weightless by being assigned as extrametrical as shown in (2.27):

(2.27)

/ˈka.ta<b>/ ‘he wrote’ /ka.ˈtab.na/ ‘we wrote’

/ˈʤa.ma<ʕ>/ ‘he gathered’ /ʤa.ˈmaʕ.na/ ‘we gathered’

The examples in (2.27) show that the final CVC syllables in /ˈka.tab/ and /ˈʤa.maʕ/ fail to attract stress and their last consonant is treated as extrametrical (weightless). However, non-final CVC syllables are considered to be heavy and they attract stress in /ka.ˈtab.na/ and /ʤa.ˈmaʕ.na/.

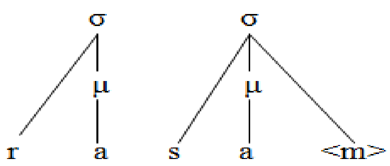
Liberman and Prince (1977) and Hayes (1979) initially proposed the notion of extrametricality in metrical theory. Then, this notion was subsequently developed in the works of Hayes (1981, 1995), Itô (1986), and Roca (1992), among others. Hayes (1995:57) states that extrametricality "designates a particular prosodic constituent as invisible for purposes of rule application". The following restrictions are proposed by Hayes (1981, 1995) in order to control extrametricality:

(2.28) Restrictions on extrametricality (Hayes 1995:57-8):

a. Constituency	Only constituents (segments, syllables, foot, phonological word, affix) may be marked as extrametrical.
b. Peripherality	A constituent may be extrametrical only if it is at a designated edge (left or right) of its domain.
c. Edge Markedness	The unmarked edge for extrametricality is the right edge.
d. Nonexhaustivity	An extrametricality rule is blocked if it would render the entire domain of stress rules extrametrical.

The angled brackets < > are usually used to mark the extrametrical element. For example, the last consonant in the word *rasam* 'he drew' is assigned extrametrical as shown in (2.29).

(2.29)



The assignment of the mora through weight-by-position is supposed to take place after consonant extrametricality as long as syllabification is achieved with reference to the algorithm in (2.30) (Clements 1990:299; Watson 2002:63):

(2.30)

a. Consonant extrametricality : C> ⟨C⟩/______]word.

b. Associate moraic segments to a syllable node.

c. Given P (an unsyllabified segment) preceding Q (a syllabified segment), adjoin P to the syllable containing Q if P has a lower sonority rank than Q (iterative).

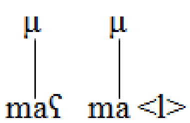
d. Given Q (a syllabified segment) followed by R (an unsyllabified segment), assign a mora to R (weight-by-position) [if R has a lower sonority rank than Q (iterative)].

e. Adjoin moraic R to the syllable containing Q (iterative).

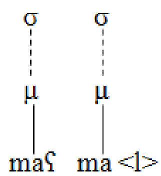
This algorithm can be exemplified in the syllabification of the word *maʕmal* ‘lab’in NA as shown in (2.31):

(2.31)

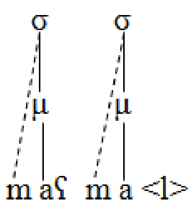
a. final consonant extrametricality



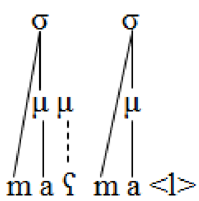
b. Association of moraic segments to a syllable node



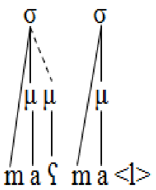
c . Association of onset to syllable node



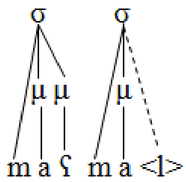
d. Assignment of mora through Weight-by-Position



e. adjunction of Weight-by-Position mora to syllable node

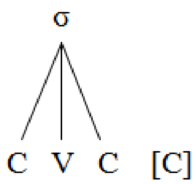


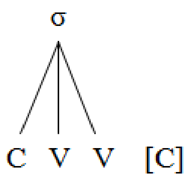
f. incorporation of extrametrical consonant into preceding syllable



Heavy and light syllables were previously distinguished based on the number of moras they have. Heavy syllables have two moras and light syllables have one mora. However, the term ‘superheavy syllable’ is appropriate for canonical-shaped syllables /CVVC/ and /CVCC/ according to studies on some Arabic dialects (Broselow 1992, Al-Mohanna 1998, Watson 2002; 2007, Kiparsky 2003, Rakhieh 2009, Al-Jarrah 2011). The initial and final positions of these syllables violate the ban on trimoraic syllables which therefore motivates scholars to propose different approaches that can account for them. For instance, Hayes (1995:106-7), Kager (1995b:376), Kenstowicz (1994:246), and Kiparsky (2003) treat the final C in superheavy syllables as *extrasyllabic* since it falls outside the syllable domain.[18]

(2.32)





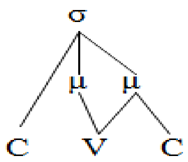
Aoun (1979) and Selkirk (1981) state that an extrasyllabic consonant is directly linked to a degenerate syllable, as shown in (2.33):

[18] Watson (2002) notes that extrasyllabic consonants block extrametricality due to the failure of achieving the Peripherality condition with reference to San’ani Arabic.

(2.33) a. CVCC b. CVVC

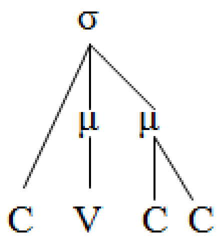
Unlike the idea of a degenerate syllable, Broselow (1992) and Watson (2007) assume that the final C in the CVVC syllable shares its mora with the previous vowel. As a result, this syllable conforms to the ban on trimoraic syllables.

(2.34)



However, Farwaneh (1995: 66-70) and McCarthy (2007:147-8) agree that the final consonants in the CVCC syllable can be linked to one mora via mora sharing if they obey sonority sequencing as shown in (2.35):

(2.35)



According to the different approaches to superheavy rhymes CVVC and CVCC, in NA, mora sharing is utilized to affiliate the last consonant in the non-final CVVC syllable to the syllable node in order to avoid a semisyllable; i.e., the last consonant shares a mora with the second member of a long vowel in a CVVC syllable. Mora sharing is used when dealing with a CVCC syllable where the last consonant cluster is assigned as a geminate; hence, the members of a geminate are directly linked to one mora. However, in NA, the last consonant in final CVVC and CVCC is deemed a degenerate syllable (extrasyllabic). These observations will be discussed in subsections (4.7.2) and (5.3.3).

To conclude, the idea behind the arguments above is that superheavy syllables violate the ban on trimoraic syllables. Interestingly, there is another behaviour where the final

C in non-final /CVVC/ and /CVCC/ is assigned a semisyllable which consequently motivates vowel epenthesis in some modern Arabic dialects. This behaviour will be discussed in the next subsection.

2.5.2 Non-final superheavy syllables and semisyllables in Arabic

In the previous section, the last C of the domain final superheavy syllables was described as extrasyllabic by Hayes (1995:106-7) and Kager (1995b:376), Kenstowicz (1994:246), and Kiparsky (2003) or as forming a degenerate syllable (Aoun 1979; Selkirk 1981). However, the same consonant is no longer assigned an extrasyllabic or a degenerated syllable in non-final superheavy syllables. It is deemed a semisyllable since it is moraic and unaffiliated to the syllable node (Kiparsky 2003). The characteristic cross-linguistic properties of semisyllables are introduced by Kiparsky (2003) as follows:

(2.36)

The characteristic cross-linguistic properties of semisyllables (Kiparsky 2003:156):

a. Unstressed, toneless, or reduced tonal contrasts.

b. Restricted segmental inventory.

c. Can be less sonorous than syllable nuclei.

d. Restricted shape (e.g. no onset, or no branching onset, no coda).

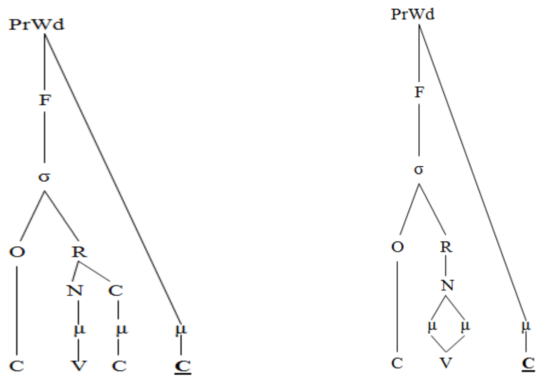
e. Sometimes restricted to peripheral position (typically word edge).

f. Prosodically invisible.

g. Can be subject to minimum sonority requirement.

Kiparsky (2003) states that the semisyllable is directly linked to a prosodic word as shown in the representations below:

(2.37)



The presence of the semisyllable does not satisfy the Strict Layering Hypothesis (SLH) (Selkirk 1984; Nespor and Vogel 1986; Itô 1986), which "requires that every non-highest prosodic element to be in its entirety a constituent belonging to the next highest category on the prosodic hierarchy".[19] (Rakhieh 2009:175).

(2.38) Prosodic Hierarchy (Roca 1994:195):

Phonological Utterance

↓

Intonational Phrase

↓

Phonological Phrase

↓

Clitic Group

↓

Prosodic Word (PrWd)

↓

Foot (F)

↓

Syllable (σ)

↓

Mora (μ)

↓

Segment

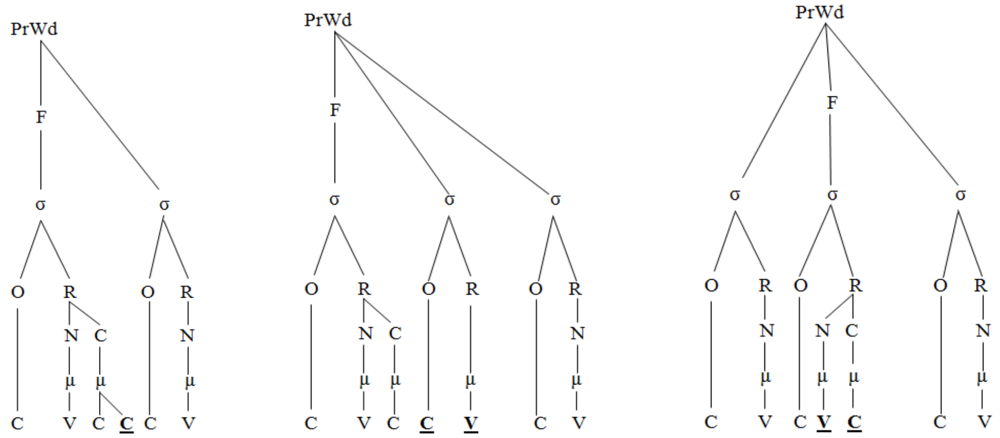
As shown in (2.38), a semisyllable is neither linked to a foot nor a syllable. It results in the fatal violation of undominated constraints on syllable and foot binary. For this

[19] Selkirk (1980a) and Nespor & Vogel (1986) define the prosodic hierarchy as a theory in which words and phrases may be parsed into prosodic constituents that form the domains of rule application.

reason, it must be linked to the prosodic word, even though it violates the SLH. There are two solutions to avoid such behaviour either by vowel epenthesis or mora sharing. Accordingly, Kiparsky (2003) and Watson (2007) classify modern Arabic dialects into three groups as C-dialect, CV-dialect, and VC-dialect depending on the way they treat semisyllables in non-final CVV.C_μ and CVC.C_μ.[20] For example, CV-dialects avoid semisyllables in non-final CVCC by allowing vowel epenthesis after a semisyllable in order to affiliate this moraic consonant to a syllable node, but the moraic syllable will consequently lose its moraicity by being resyllabified as an onset of the syllable in which an epenthetic vowel is employed as its nucleus. Unlike CV-dialects, VC-dialects allow vowel epenthesis before a semisyllable. Mora sharing is used to affiliate a semisyllable in a non-final CVCC in C-dialects rather than vowel epenthesis if a final CC conforms to sonority sequencing as shown in (2.39).

(2.39)

a. C-dialect b. CV-dialect c. VC-dialect

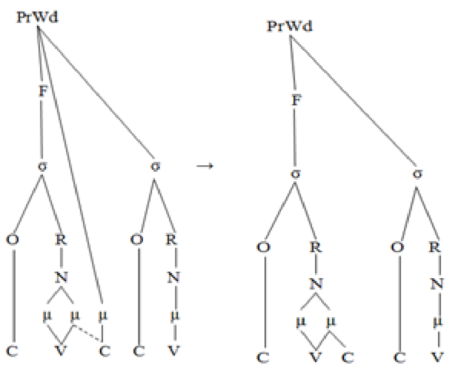


The representations in (2.39) show the difference between the three groups of modern Arabic dialects depending on the treatment of a semisyllable that precedes a syllable with a short vowel. In C-dialects, a semisyllable is affiliated to the syllable node through mora sharing if the final consonant cluster obeys sonority sequencing, whereas both CV and VC-dialects permit vowel epenthesis at different places; hence, CV-dialects allow vowel epenthesis after a semisyllable while VC-dialects do the opposite by allowing vowel epenthesis before a semisyllable in order to resyllabify this moraic consonant as a coda of a syllable in which an epenthetic vowel represents its nucleus.

[20] Bamakhramah (2009) states that a non-final superheavy syllable is a heavy syllable of the form CVC or CVV followed by a semisyllable.

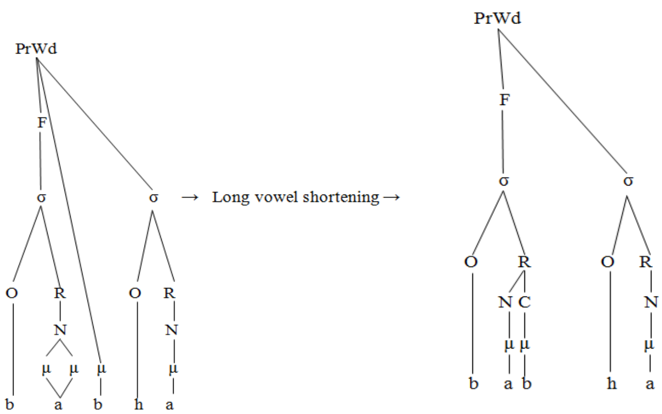
However, a semisyllable that follows a syllable with a long vowel is treated differently among these groups of modern Arabic dialects in general and some dialects which belong to CV-dialect in particular. For instance, C and VC-dialects permit mora sharing to affiliate a semisyllable to a syllable node if the preceding syllable has a long vowel (Watson 2007). In this case, the second mora will dominate the first segment as a second member of a long vowel and the second segment as a semisyllable as shown in (2.40):

(2.40)

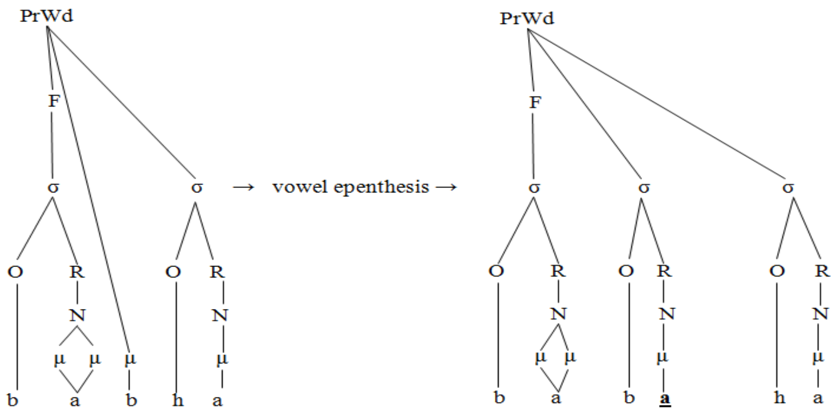


Similarly, some dialects that belong to CV-dialects permit mora sharing to affiliate a semisyllable to a syllable node as do C and VC-dialects like Ma'ani Arabic (Rakhieh 2009) while other dialects which belong to the same group ban mora sharing by allowing long vowel shortening like Cairene Arabic (Watson 2007) or vowel epenthesis as in UHA (Al-Mohanna 1998). Consider the following representations of the input /baa.b$_{\mu}$.ha/ 'her door':

(2.41) a. Cairene Arabic /ba:.b$_{\mu}$.ha/→ [bab.ha]



b. UHA (Urban Hijazi Arabic) /ba:.b_{μ}.ha/→ [ba:.b**a**.ha]



The representations above suggest that not all dialects that belong to CV-dialect avoid a semisyllable by allowing vowel epenthesis. Some dialects in CV group permit mora sharing when a semisyllable follows a syllable with a long vowel while other dialects from the same group either permit long vowel shortening or vowel epenthesis to affiliate a semisyllable to a syllable node. These syllable structure processes that are motivated by a semisyllable will be illustrated in detail in the third and fifth chapters. In the next section, I will illustrate Optimality Theory (OT) in general and show how this framework is capable of providing analyses of syllable structure processes, as a central focus of this thesis.

2.6 Optimality Theory

Syllable structure analysis has been analysed in the phonological literature by many researchers (Kar 2009). Different approaches have been applied to the analysis of syllable structure, but OT has become the most important and powerful framework for the analysis of syllable structure since its debut in 1993 (McCarthy& Prince 1993a, 1993b; Prince & Smolensky 1993). Over the past twenty years this theory has proved useful in accounting for the relationship between a given input and a particular surface form. Accordingly, I will use this theory to analyse the syllable structure in NA and related processes such as epenthesis, metathesis, vowel shortening, and syncope.

The motivation for using OT is that this theory employs its five fundamental principles that are identified by Prince and Smolensky (1993) and McCarthy and Prince (1996) when dealing with some of the problematic issues in phonology. For instance, one of these problems is the conspiracy problem in Yawelmani Yokuts (Kisseberth 1970). The sequence CCC is not permitted in Yawelmani Yokuts. For this reason, this sequence is repaired by inserting an epenthetic vowel after the first consonant; i.e. C**v**CC. However, neither C*v*CC nor CC*v*C is allowed in Yawelmani Yokuts. Therefore, the other repair strategy to avoid the sequence CCC is the deletion that targets a consonant that is not adjacent to a vowel; i.e., in a sequence like … VC+CCV…, the second consonant is deleted. These rules are aimed at the same goal, which is to avoid the sequence of CCC. In the mid-1970s, non-linear theories including Austosegmental Phonology (Goldsmith 1976) and Metrical Phonology (Liberman 1975 and Liberman and Prince 1977) helped to limit the operation of rules; the role of the rule component is narrowed due to constraints on representations. However,

> "the proposed universal constraints did not hold in every language all of the time.That is why the subsequent literature on autosegmental and metrical phonology, such as Pulleyblank (1986) and Hayes (1995), returned to language-particular rewrite rules as the central analytic mechanism" McCarthy (2008:6).

By the end of the 1980s, the importance of output constraints was recognized by phonologists including Paradis (1988) and Kaye et al (1985;1990).The theory of Constraint and Repair Strategy was introduced by Paradis (1988). This theory explains that any violations resulting from constraint conflicts can be resolved by a set of inviolable surface constraints accompanied by repair strategies. Kaye et al (1985; 1990) introduced Government Phonology that accounts for phonological processes by replacing rules with a restricted set of universal principles and a series of language specific-parameters. Output constraints play an important role in the emergence of the theory of constraint interaction, or, OT (McCarthy& Prince 1993a, 1993b; Prince & Smolensky 1993). The reason for using OT as a framework is because OT can account for syllable structure processes in NA using the unified set of OT constraints rather than using different rules. Furthermore, re-write rules fail to capture the grammar generalization of NA grammar that OT captures as discussed in chapter 5.

The mechanism of OT is merely defined as a relation between input and output in which every input has a precise output (McCarthy 2008). To operate this mechanism, two main components, namely GEN and EVAL, should be in any grammar (Kager 1999). OT is discriminated as a theory of parallel input-output relation by these components. GEN, which stands for ‘GENERATOR’, functionally generates an infinite number of possible candidates without any restriction while EVAL, which stands for ‘EVALUATOR’, evaluates candidate analyses generated by GEN through constraints that are ranked on a scale of language-particular phenomenon. EVAL then determines an optimal candidate among other competing candidates (Kager 1999). The relation between both components is interpreted by a flowchart (2.42) below:

(2.42) Input → GEN→ Candidates→ EVAL → Output (McCarthy 2008:19)

CON (CONSTRAINT) is well- known as a component that is used by EVAL in order to evaluate candidate analyses generated by GEN and determine the optimal output. In fact, constraints are universal, but the ranking of constraints can be attributed to the differences between languages. This means that the ranking of constraints is not universal since it is specific to a certain language. For example, ONS, as a constraint, is ranked higher in languages that have no onsetless syllables, like Arabic, whereas it is ranked lower in languages that allow onsetless syllables. ONS, as a constraint, is universal, but the way it is ranked is not universal. Constraints are subject to violations by candidate analyses. The entire constraints might be violated in some languages and not violated in others. Also, an optimal output should not necessarily avoid the violation of all constraints with respect to a set of ranked constraints; it should minimally violate constraints in order to become the most harmonic candidate. Along with GEN and EVAL, the grammar contains a ‘LEXICON’ in which lexical representations (underlying forms) form the input to GEN (Kager 2010:19). This component is not restricted by constraints, unlike outputs, and the component does not undergo evaluation by constraints. This idea invokes the ‘Richness of the Base’ hypothesis, introduced by Prince and Smolensky (1993) and Smolensky (1996). This hypothesis says that “no constraints hold at the level of underlying forms” (Kager 2010:19). Smolensky (1993, 1997) argues that the interaction between constraints reaches the output level but never reaches the input.

There are two types of constraint in OT: Markedness and Faithfulness constraints. Markedness constraints make general statements about well-formedness while faithfulness constraints require perfect correspondence between the input and the output (Prince and Smolensky 2004). This means that markedness constraints require outputs to be structurally well-formed; these constraints require outputs to avoid certain marked structures. Below are some examples of markedness constraints:

(2.43)

a. *V $_{NASAL}$

Vowels must not be nasal.

b. *VOICED-CODA

Obstruents must not be voiced in the coda position.

c. *[ŋ

No word-initial velar nasal.

d. NO-CODA

Syllables are open.

e. *CLASH

No adjacent syllables are stressed.

f. ONSET

Syllables must have onsets.

(Rakhieh 2009:18)

Faithfulness constraints require outputs to be faithful to the input. This means that these constraints are violated by outputs that are not identical to the input. There are two classes of faithfulness constraints: MAX and DEP. The MAX constraint is concerned with the correspondence of the properties of the input and the output which means that the violation of this constraint concerns deleting the properties of the output which are identical to those in the input. DEP demands that the output should correspond to the input without adding any extra segment to the properties of the output. In other words, DEP is violated by having an extra property in the output which is not found in the input (no insertion).[21] Al-Mohanna (1998) gives an example of the interaction between markedness and faithfulness constraints in terms of the evaluation of the candidates of the input /VC/ in Urban Hijazi Arabic (UHA).[22] Consider the following tableau below:

[21] PARSE and FILL which are found in the original work of Prince and Smolensky (1993) are substituted with MAX and DEP.
[22] Al-Mohanna (1998) referred to -COD which is known as NO-CODA by Kager (2010:94).

(2.44)

/VC/	ONS	MAX	DEP	-COD
a.☞ /CVC/			*	*
b. /CV/		*!	*	
c. /VC/	*!			*

The tableau (2.44) identifies output (a) as the optimal candidate since it avoids the violation of highly-ranked constraints, but output (c), which is the most faithful candidate to the input, is eliminated from being optimal due to the violation of ONS as the most highly-ranked constraint. Output (b) avoids the violation of ONS and -COD, but it violates MAX due to the deletion of the coda. In the next section, I will show how the interaction between markedness and faithfulness constraints is useful for the analysis of syllable structure processes such as insertion (epenthesis), CV-metathesis, vowel shortening, and deletion.

2.6.1 Syllable Structure processes in OT

2.6.1.1 Insertion (epenthesis)

In the previous section, OT was demonstrated as a framework that is useful for evaluating the candidates of the input /VC/ in UHA via the interaction between markedness and faithfulness constraints. This interaction can be used for analysing vowel epenthesis as well as syncope, vowel shortening, and CV metathesis. Accordingly, Jarrah (2013) adopts OT for the analysis of syllable structure in Madina Hijazi Arabic (MHA). He refers to the interaction between ONS and DEP in order to evaluate the candidates of the input /ankatab/ 'it was written'. Consider the following tableau:

(2.45)

/ankatab/	ONS	DEP-IO
a. ankatab	*!	
b.☞ ʔankatab		*

The tableau (2.45) shows that the output (a), as an onsetless syllable, cannot be optimal due to the violation of ONS, whereas output (b) avoids this violation through an epenthetic glottal stop in order to be selected as optimal. Al-Mohanna (1998) presents another example in UHA in which OT can distinguish between peripheral and internal epenthesis using the O-CONTIG constraint (McCarthy and Prince 1995).The candidates of the input /stak.tab/ 'caused to write' are evaluated in the next tableau:

(2.46) ONS, *COMPLEX>>O-CONTIG>>DEP-IO>>-CODA

/stak.tab/	**ONS**	***COMPLEX**	**O-CONTIG**	**DEP-IO**	**-CODA**
a. stak.tab		*!			**
b. s**v**.tak.tab			*!	*	**
c. ☞ **ʔi**s.tak.tab				**	***
d. **v**s.tak.tab	*!			*	**

O-CONTIG is revealed in the tableau (2.46) as a constraint that is useful for the elimination of candidates that include internal epenthesis like the candidate (b). As a result, output (c) becomes an optimal candidate due to the satisfaction of highly-ranked constraints including O-CONTIG. Clearly, OT has proved its potential in the analysis of insertion (epenthesis). In the next subsection, syncope undergoes OT analysis.

2.6.1.2 Syncope

In the previous subsection, OT was shown as a framework that has the potential to analyse internal and peripheral epenthesis via the interaction between markedness and faithfulness constraints like ONS, *COMPLEX, O-CONTIG, DEP-IO, and -CODA. In this subsection, I will show how OT is also capable of analysing syncope by giving some examples of cases where syncope is analysed using OT as an analytical framework. Firstly, Al-Mohanna (1998) takes syncope in UHA into consideration with reference to OT in order to evaluate the candidates of the input /ʃaatˤir+ah/ 'she is smart' using the following set of constraints:

(2.47)

a. *COMPLEX (McCarthy 2008):

Assign one violation-mark for every complex onset or complex coda.

b. MAX-Low V (Al-Mohanna 1998):

A low vowel in the input must have a correspondent in the output.

c. MAX-Hi V (Al-Mohanna 1998):

A high vowel in the input must have a correspondent in the output.

d. SYL-Min (Wd-Intel) (Al-Mohanna 1998):

Word internal light syllables are prohibited.

(2.48) *COMPLEX>>MAX-Low V >>SYL-Min (Wd-Intel)>>MAX-Hi V

/ʃa:tˤir+ah/	***COMPLEX**	**MAX-Low V**	**SYL-Mi(Wd-Intel)**	**MAX-Hi V**
a. ☞ ʃa:tˤ.rah				*
b. ʃa:.tˤi.rah			*!	

The candidate (b) is eliminated in tableau (2.48) due to an unstressed short vowel in a light penultimate syllable which therefore violates SYL-Min (Wd-Intel), while output (a) is optimal since it satisfies the same constraint. Clearly, the interaction between markedness constraints, *COMPLEX and SYL-Min (Wd-Intel), and faithfulness constraints, MAX-Low V and MAX-Hi V, is useful for the analysis of syncope in UHA.

The second example comes from Rose (2000) who analyses syncope in Classical Arabic (CA) using OT. She uses the following constraints to evaluate the candidates of the input /madad-a/ ‘he extended’:

(2.49)

a. Obligatory Contour Principle (OCP) (Rose 2000:04):[23]

A sequence of adjacent identical segments is disallowed.

[23] Rose adheres to McCarthy (1986) and Keer (1999) in order to use the OCP constraint that militates against antigemination, resulting from vowel epenthesis which is inserted to split the members of a geminate.

b. *GEM (Rose 2000):

Long segments are disallowed.

c. MAX-IO (McCarthy 1995)

Every segment of the input has a correspondent in the output (no deletion).

(2.50) OCP>>*GEM, MAX-IO

/madad-a/	OCP	*GEM	MAX-IO
a. ☞ madda		*	*
b. madada	*!		

The tableau (2.50) identifies output (a) as the optimal candidate because an unstressed short vowel in a light penultimate syllable results from a vowel-initial affix is targeted by syncope in order to satisfy OCP as the most highly-ranked constraint. Unlike optimal candidate (a), the members of a geminate are split by internal epenthesis in output (b) which results in the failure to satisfy OCP.

2.6.1.3 Vowel shortening

Some examples in the previous section demonstrated how OT can analyse syncope that targets an unstressed short vowel in a light penultimate syllable in the case of UHA (Al-Mohanna 1998), and CA (Rose 2000). In this section, I will refer to some examples that show how OT is used for the analysis of long vowel shortening. The first example is a case of long vowel shortening in UHA using OT (Al-Mohanna 1998). The candidates of the input /ʤa:.b$_{\mu}$+l$_{\mu}$+i/ 'he brought to me' are evaluated in the next tableau using the following constraints:

(2.51)

a. Syllable Maximality (SYL-MAX) (Al-Mohanna 1998):

Syllables are maximally *bi*-moraic.

b. Syllable Minimality (SYL-MIN) (Al-Mohanna 1998):

Syllables are minimally *bi*-moraic.

c. DEP-IO (McCarthy and Prince 1995):

Every segment of the output has a correspondent in the input. (Prohibits phonological epenthesis).

d. MAX(μ) (McCarthy and Prince 1995) :

Every mora in S1 has a correspondent in S2 (no deletion of moras).

e. O-CONTIG (CONTIGUITY-IO) ("No Insertion") (McCarthy& Prince 1995):

The portion of S2 standing in correspondence forms a contiguous string.

f. Syll-ALIGN (R) : Align (Syll, R, PrWd, R) (Mester & Padgett 1994)):

Every syllable must be left-edge aligned with the left edge of the prosodic word.

g. *CODA (Prince and Smolensky 2004):

Syllables must not have codas.

(2.52) SYL-MAX>>DEP-IO>>O-CONTIG>>MAX(μ)>>SYL-MIN>>Syll-ALIGN(R)>>*CODA

/ʤa:.b_μ+l_μ+i/	**SYL-MAX**	**DEP-IO**	**O-CONTIG**	**MAX(μ)**	**SYL-MIN**	**Syll-ALIGN(R)**	***CODA**
a.☞ ʤab.li				*	*	μ	*
b. ʤa:.b**a̲**.li		*!	*		**	μμ	
c. ʤa:b.li	*!				*	μ	*

Output (a) is optimised in the tableau (2.52) due to the satisfaction of highly-ranked constraints like SYL-MAX, DEP-IO, and O-CONTIG. Output (b) satisfies SYLL-

MAX by resyllabifying /b/ as an onset of the following syllable where an epenthetic vowel is employed as its nucleus but fails to be optimal due to the violation of DEP-IO. The immunity to vowel epenthesis in output (c) results in the violation of SYL-MAX; therefore, this candidate is prevented from being optimal.

Gouskova (2003) gives another example of vowel shortening in word-final syllables in Hopi using OT. She uses some constraints that are used for the analysis of this behaviour like NONFINALITY(σ), WSP, and MAX(μ). The candidates of the input /panaa/ 'act on'.

(2.53)

a. NONFINALITY(σ) (Alderete 1995):

The final syllable in nouns, adjectives, and adverbs is not a head.

b. WSP (Weight-To-Stress-Principle) (McCarthy& Prince, 1995 2004):

Heavy syllables are prominent both on the grid and foot structure.

c. MAX(μ) (McCarthy and Prince 1995):

Every mora in S1 has a correspondent in S2 (no deletion of moras

/panaa/	**NONFINALITY(σ)**	**WSP**	**MAX(μ)**
a. ☞ (pána)			*
b. (pánaa)		* !	
c. (panáa)	* !		

The tableau (2.53) identifies output (a) as an optimal candidate since it escapes from the violation of highly-ranked constraints, unlike the outputs (b) and (c); output (b) satisfies NONFINALITY(σ) by having a head in the non-final position, but it fails to avoid the violation of WSP due to an unstressed heavy syllable in the final position while output (c) does the opposite by assigning stress to the final heavy syllable. However, this process results in the violation of NONFINALITY(σ). Therefore, this output is eliminated from being optimal as well as output (b). The last syllable structure process, CV-metathesis, will be illustrated in light of OT in the next subsection.

2.6.1.4 CV-metathesis

OT has been demonstrated in the previous subsections to be a framework that is capable of analysing syllable structure processes such as epenthesis, syncope, and vowel shortening via the interaction between faithfulness and markedness constraints. Recently, this theory has been shown to be a framework that can be used for the analysis of CV-metathesis by Pater (2003), and Ahmadkhani (2008). Pater (2003) uses OT for the analysis of CV-metathesis in Balantak.[24] He uses the constraints below in order to evaluate the candidates of the input /$sara_1t_2$+μ_3m_4/ 'your foot':

(2.54)

a. *C/VFEAT (Pater 2003)

Oral consonants are not specified for vocalic features.

b. LINEARAITY (Pater 1995)

S_1 reflects the precedence structure of S_2, and vice versa.

c. MAX-C (McCarthy and Prince 1995):

Do not delete a consonant.

(2.55) *C/VFEAT>> LINEARITY>>MAX-C

/$sara_1t_2$+μ_3m_4/	*C/VFEAT	LINEARITY	MAX-C
a. ☞ $sara_1a_3t_2$		*	*
b. $sara_1t_2a_3m_4$	*!		

Output (a) is determined in the tableau (2.55) as an optimal candidate analysis due to the satisfaction of *C/VFEAT as the most highly-ranked constraint. This satisfaction is achieved by the deletion of the final consonant. The preceding vowel will then be metathesized with an oral consonant /t/ in order to avoid an intervocalic oral consonant. These processes result in the violation of LINEARITY and MAX-C constraints. Unlike

[24] Balantak is the main language of the head of the eastern peninsula of Sulawesi.

the optimal candidate analysis, output (b) is immune to the deletion of final consonant and metathesis. As a result, it fails to avoid the violation of the *C/VFEAT constraint due to an intervocalic oral consonant /t/.

Ahmadkhani (2008) uses OT in order to analyse CV-metathesis in Persian. He evaluates the candidates of the input /draya/ 'sea' using the *COMPLEX and LINERAITY constraints. Consider the following tableau:

(2.56)

*COMPLEX>> LINEARITY

/draya/	*COMPLEX	LINEARITY
a. draya	*!	
b. ☞darya		*

Output (b) achieves optimisation by the satisfaction of the *COMPLEX constraint; hence, this candidate permits the metathesis of /r/ and /a/ in order to avoid a complex onset, whereas output (a) has a complex onset which violates *COMPLEX. Therefore, this candidate is prevented from being optimal.

2.7 Conclusion

This chapter clarified some theoretical background knowledge about the syllable and OT as an analytical framework. This chapter consists of five main sections: The phonological role of the syllable in the overall theory of grammar, the internal structure of the syllable, sonority hierarchy and the syllable, the syllable in Arabic, and OT. In the first main section, the phonological role of the syllable in the theory of grammar was demonstrated through three examples; the syllable and phonotactic constraints, the syllable and segmental phonology, and the syllable and suprasegmental phonology (stress assignment). According to Kahn (1976), the syllable boundary is used to recognise the hypothetical *atktin* as an impossible word in English because the word initial cluster /kt-/ is impossible in English as well as the word-final cluster /-tk/. The syllable and suprasegmental phonology is supported by Al-ani (1970) and McCarthy (1979a, 1979b). Both scholars agreed on stress parameters being determined by the syllable weight and position with reference to CA.

The internal structure of the syllable was introduced in the second main section along with the adopted syllable theory, the moraic model. In this section, the nucleus was also shown as the obligatory constituent in the syllable which influenced the presence of any syllable; the deletion of this constituent led to the deletion of the entire syllable and vice versa.

The third main section introduced the relation between the syllable and the sonority hierarchy. The universal sonority scale (Selkirk 1984) is mentioned at the beginning of this section in order to show the sonority values of segments . However, this sonority scale could not discriminate between the sonority values of obstruents. Therefore, Parker (2002, 2008) contributed to this field by presenting a comprehensive sonority scale that could precisely distinguish between the sonority values of obstruents, including affricates. Roca and Johnson (1999) addressed some impossible initial consonant clusters in English like /ps-/ and /pn-/ which were permitted in Greek. They attributed this behaviour to the MSD (Minimal Sonority Distance) (Selkirk 1984; Clements 1990). Parker's (2008) sonority scale can also be used to detect sonority violation in the coda position. This statement is explained in detalis in subsection 5.3.2.1.1.

After giving some theoretical background knowledge about the syllable, the fourth main section was about the syllable in Arabic. It began by analysing syllable types in SA (Standard Arabic) in order to see which syllable types were accommodated by modern Arabic dialects and which syllable types in these dialects were not found in SA. This section was followed by two subsections; the first subsection was concerned with the notion of extrametricality and syllable weight in Arabic while the second subsection focused on the non-final superheavy syllable and semisyllables; this section demonstrated the different treatments of semisyllables in modern Arabic dialects.

The final section illustrated OT, as a framework; hence, this section began with a description of this theory. It then showed how it made possible the analysis of syllable structure processes like insertion (epenthesis), syncope, vowel shortening, and CV-metathesis, via the interaction between markedness and faithfulness constraints. The next chapter will specifically deal with these major syllable structure processes in modern Arabic dialects by looking at the motivating factors for these processes.

Chapter 3. Overview of Major Syllable Structure Processes in Arabic

3.1 Introduction

Theoretical background knowledge about syllable structure was demonstrated in the previous chapter in terms of its relation to an overall theory of grammar through key examples: the phonotactic constraints, segmental and suprasegmental phonology. Both the structure of the syllable, the syllable and sonority hierarchy, OT, and syllable structure processes in OT were also explained in detail in the previous chapter. The availability of any syllable relies on the presence of the nucleus, and the deletion of any syllable can be attributed to the deletion of a nucleus (syncope). Furthermore, the insertion of any new syllable depends on the insertion of a nucleus (epenthesis). In this chapter, I will review previous studies in some modern Arabic dialects where phonological processes such as epenthesis, metathesis, vowel shortening, and deletion have an impact on syllable structure. Moreover, I will examine factors that motivate these processes. The next section will begin with the motivators for vowel epenthesis.

3.2 Previous studies of Epenthesis

3.2.1 Sonority and Epenthesis

The relation between sonority and syllable structure has been noted by scholars such as Abdul-Karim (1980), Jarrah (1993), Ingham (1994), Al-Mohanna (1998), Gouskova & Hall (2009), Rakhieh (2009), and Ibrahim (2012). They unanimously agree on the relationship between sonority and syllable structure, with sonority rising from the onset upwards to a peak and falling towards a coda boundary. In other words, they exemplify the sonority process as a curve in which the sonority goes upwards to a peak and falls towards a coda. However, they observe that some syllable types that have initial or final bi-consonantal clusters violate the Sonority Sequencing Principle (SSP). As discussed in section 2.4, this behaviour is noted by Clements (1990) who describes two manners of violation of sonority: Plateau Sonority and Reverse Sonority. According to Clements (1990), Blevins (1996), and Carlisle (2001), Sonority Plateau describes a consonant cluster in which its members are equally sonorous either in the onset or coda position. Reverse Sonority is when peripheral segments in onsets or codas are more sonorous than those closer to the nucleus. In this subsection, I will describe the case in which epenthesis is used as a solution to avoid sonority violation.

Abdul-Karim (1980:32-33) concentrates on epenthesis in Lebanese Arabic. He observes that vowel epenthesis is obligatory in some final consonant clusters and optional in others. In (3.1) below, Abdul-Karim (1980:32-33) presents these clusters:

(3.1)

a. /ʔism/ [ʔis**i**m] 'name'
b. /ʔibn/ [ʔib**i**n] 'son'

He notes that final consonant clusters in words in (3.1) are broken up by epenthetic vowels because the peripheral consonants are more sonorous than consonants that are closer to the nucleus. Therefore, the final consonant clusters have to be broken up in order to obey sonority. Otherwise, the sonority would rise again in the coda position.

Jarrah (1993) accounts for the phonology of Medinah Hijazi Arabic (MHA). He examines the relation between the syllable structure in this dialect and sonority sequencing, and observes that the violation of sonority is solved by epenthesis rather than deletion or metathesis. He presents some words in MHA which have final clusters that violate the SSP:

(3.2) Final consonant clusters in MHA that violate sonority sequencing

a./ħibr/	ħib**i**r	'ink'
b./ʤism/	ʤis**i**m	'part
c. /rubʕ/	rub**u**ʕ	'quarter'
d. /ħukm/	ħukum	'verdict'
e. /faħm/	faħam	'coal'
f. /baħr/	baħ**a**r	'sea'
g. /ħabl/	ħab**i**l	'rope'
h. /ʔakl/	ʔak**i**l	'eating'
i. /faʤr/	faʤ**u**r	'dawn'
j. /sˤabr/	sˤab**u**r	'patience
k. /gasˤr/	gasˤ**u**r	'palace'

The words above become disyllabic since the epenthetic vowels have separated the members of the final clusters; hence, these words have a syllable structure in the canonical shape CVCC, but when insertion takes place in the middle of final clusters, words become disyllabic; e.g., CVCC→ vowel insertion → CV.C**v**C. Words in (3.2) have final clusters that violate the SSP; the peripheral segments are more sonorous than those closer to the nucleus. Therefore, epenthetic vowels are permitted to break these clusters up as a solution to the violation of the SSP. This shows the impact of sonority on syllable structure, because the violation of sonority has been avoided by vowel epenthesis which results from having two syllables instead of one. After inserting a vowel internally, the first member of the final cluster has been resyllabified as an onset of the following syllable in which an epenthetic vowel is employed as its nucleus, whereas the second member of the final cluster has become a coda of a newly-created syllable. However, Jarrah (1993) offers the exceptional case in which final clusters in some words that violate the SSP remain. Vowel insertion may change the lexical categories of words; he presents words that are derived from verbs by inserting vowels in the middle of final consonant clusters:

(3.3) Lexical distinctness

a) /madħ/ 'praising' → vowel epenthesis → [ma.d**a**ħ] ‘to praise’

b) /daʕm/ ‘support (noun)’→ vowel epenthesis → [da.ʕ**a**m] ‘to support’

c) /tˤaʕn/ ‘stabbing’→ vowel epenthesis → [tˤa.ʕ**a**n] ‘to stab’

d) /tˤaħn/ ‘grinding’→ vowel epenthesis→ [tˤa.ħ**a**n] ‘to grind’

e) /lakm/ ‘punching’→ vowel epenthesis → [la.k**a**m] ‘to punch’

f) /fatħ/ ‘opening’→ vowel epenthesis→ [fa.t**a**ħ] ‘to open’

g) /dafn/ ‘burying’→ vowel epenthesis→ [da.f**a**n] ‘to bury’

h) /χasˤm/ ‘discount’→ vowel epenthesis [χa.sˤ**a**m] ‘to discount’

Despite SSP violation, vowel epenthesis does not occur in words in (3.3) due to lexical homonomy avoidance. Jarrah (1993) sheds light on the identity of epenthetic vowels: epenthetic vowels are determined by a stem vowel and a first member of a final cluster:

(3.4) Identity of vowel epenthesis

(I) a) /ʔidn/→ [ʔi.d**i̲**n] 'ear'

b) /ħibr/→ [ħi.b**i̲**r] 'ink'

c) /tˤifl/→ [tˤi.f**i̲**l] 'baby'

d) /ʤism/→ [ʤi.s**i̲**m] 'body'

(II) a) /gutˤn/→ [gu.tˤ**u̲**n] 'cotton'

b) /rubʕ/→ [rub**u̲**ʕ] 'quarter'

c) /ħukm/→ [ħu.k**u̲**m] 'verdict'

d) /suʕr/ → [su.ʕ**u̲**r] ‘calory’

(III) a) /baħr/ → [baħ**a̲**r] 'sea'

b) /nahr/ → [na.h**a̲**r] 'river'

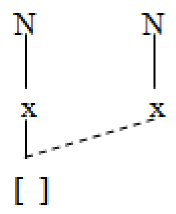
c) /ʃaʕr/ → [ʃa.ʕ**a̲**r] 'hair'

d) /naχl/ → [na.χ**a̲**l] 'palm trees'

e) /laʁm/ → [laʁ**a̲**m] 'mine'

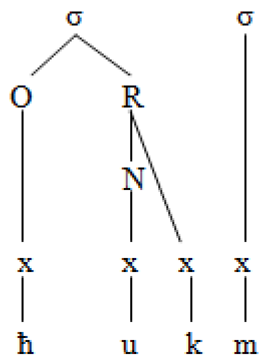
He states that epenthetic vowels in words in (3.4-I and II) are determined by stem vowels; the epenthetic vowel [i] in words in (3.4-I) is determined by the stem vowel /i/ while the epenthetic vowel [u] is determined by the stem vowel /u/ in words in (3.4-II). According to him, both epenthetic vowels [i] and [u] are subject to progressive harmony from the stem vowel based on the vowel melody spread rule shown in (3.5):

(3.5)



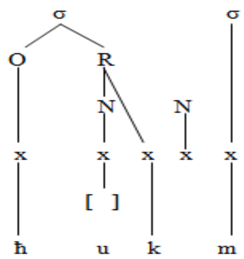
By taking the example of the epenthetic vowel [u] in the output [ħu.k**u**m] ‘verdict’, the vowel melody spread in (3.5) can be applied in three steps. The first step is to show an underlying form as in (3.6):

(3.6)



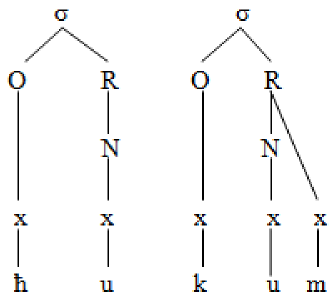
The second step is to insert a vowel slot, a vowel slot is inserted on the skeletal tier as in (3.7)

(3.7)



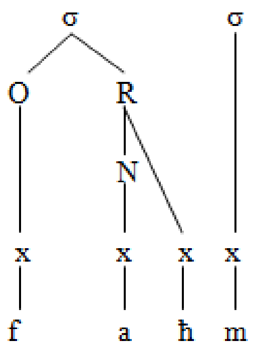
In the final step, a vowel slot is filled by the spreading of a stem vowel matrix rightward on the skeletal tier as in (3.8):

(3.8)



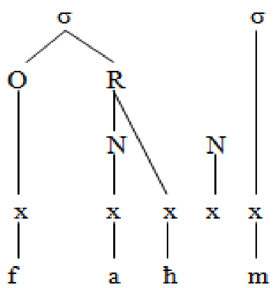
The epenthetic vowel /a/ in (3.4-III) is determined by a [+ Pharyngeal] consonant as the first member of the final consonant cluster. Jarrah (1993) states that guttural consonants spread the [+Pharyngeal] feature to the adjacent vowel slot on the skeletal tier. This spreading is achieved by three steps. The first step is to introduce the underlying form; consider the following representation of the input /faħm/ 'coal'.

(3.9)



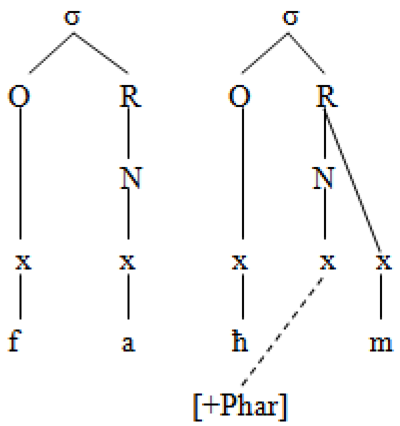
In the second step, a vowel slot is inserted on the skeletal tier as shown in (3.10).

(3.10)



The final is step is that the guttural consonant will spread the [+Pharyngeal] feature to the adjacent vowel slot as in (3.11):

(3.11)



However, Jarrah (1993) presents the exceptional case in which vowel epenthesis is neither determined by a stem vowel nor a [+pharyngeal] consonant, as in (3.12) below:

(3.12)

(I) a) /ʕagl/→ [ʕa.g**i**l] 'mind'

b) /ʔakl/→ [ʔa.k**i**l] 'food'

c) /ħabl/→ [ħa.b**i**l] 'rope'

(II) a) /sˤabr/→ [sˤa.b**u**r] 'patience'

b) /fadʒr/→ [fa.dʒ**u**r] 'dawn'

c) /tamr/→ [ta.m**u**r] 'dates'

Since the epenthetic vowels [i] and [u] in (3.12) are neither determined by stem vowels nor first members of final consonant clusters, Jarrah (1993:107) reaches the generalisation that an epenthetic vowel [i] occurs between [-pharyngeal] and /l/, as a lateral, and an epenthetic vowel [u] occurs between [-pharyngeal] and /r/.

Ingham (1994) concentrates on NA, as one of the common dialects in Saudi Arabic. He demonstrates the phonology of this dialect as well as other linguistic aspects, syntax and semantics. He observes that peripheral sonorant consonants such as /n/, /m/, /l/, /r/ in final consonant clusters motivate vowel epenthesis, especially if the consonants closer to nucleus are obstruents, even though he does not analyse this case in terms of the SSP. Consider the following examples:

(3.13) Final consonant clusters that motivate vowel epenthesis in NA

a) /ħaml/ → [ħa.m**i**l] ‘burden’

b) /sˤabr/ → [sˤa.b**u**r] ‘patience’

c) /masˤr/ → [ma.sˤ**u**r] ‘Egypt’

d) /radʒl/ → [ra.dʒ**i**l] ‘husband’

e) /badw/→ [ba.d**u**w] ‘Bedouins’

f) /tˤilj/ → [tˤi.l**i**j] ‘lamb’

The words in (3.13) have final consonant clusters that motivate vowel epenthesis due to peripheral segments which are more sonorous than those closer to the nucleus. As a result, the canonical shape of these words has been changed due to vowel epenthesis; these words become disyllabic because vowel epenthesis is employed as a nucleus of a newly-created syllable. Furthermore, the first members of the final consonant cluster have been resyllabified as onsets of the following syllable (a newly-created syllable), whereas the second members have been resyllablfied as codas of the same new syllables.

Al-Mohanna (1998) sheds light on syllabification and mertification in UHA. He concentrates on the relationship between syllable structure in UHA and the SSP and how the violation of the SSP motivates vowel epenthesis, resulting in disyllabic words. In other words, he considers some factors that have a tangible impact on the syllable structure in UHA, and one of them is the violation of the SSP. He uses, as an example, words which have final consonant clusters that violate the SSP, as in (3.14):

(3.14) Final consonant clusters against the SSP in UHA

a) /dʒi**sm**/ → [dʒi.s**i**m] ‘body’

b) /ʔiðn/→ [ʔi.ð**i**n] ‘ear’

c) /ħukm/→ [ħu.k**u**m] ‘verdict’

d) /faħm/→ [fa.ħ**a**m] ‘coal’

e) /nahr/→ [na.h**a**r] ‘river’

f) /ʔakl/→ [ʔa.k**i**l] ‘food’

g) /ħabl/→ [ħa.b**i**l] ‘rope’

h) /sˤabr/ → [sˤa.b**u**r] ‘patience’

i) /fadʒr/→ [fadʒ**u**r] ‘dawn’

The words in (3.14) motivate vowel epenthesis by having final consonant clusters that do not obey the SSP. Al-Mohanna (1998) points out that peripheral segments are more sonorous than those closer to the nucleus. Therefore, vowel epenthesis is necessary in order to break up these consonant clusters. Reverse sonority in the coda position in Urban Hijazi Arabic provokes vowel epenthesis (Al-Mohanna 1998). As a result, words become disyllabic after breaking up final consonant clusters by vowel epenthesis; e.g., /ʔakl/ (CVCC) → [ʔa.k**i**l] (CV. C**v**C). This behaviour is accounted for by Al-Mohanna (1998) within OT; he evaluates the candidates of the input /nahr/ in (3.15) below:

(3.15) ONS>>*COMPLEX>>SSP>>MAX-IO>> DEP-IO>>-CODA

/nahr/	ONS	*COMPLEX	SSP	MAX-IO	DEP-IO	-CODA
a. nahr		*!	*			**
b. na.h**a**r					*	*
☹ c. nah.ri					*	*

The tableau (3.15) could not discriminate any candidate as optimal. The candidate (a) violates the *COMPLEX constraint due to the final consonant cluster. Both candidates (b) and (c) violate the DEP-IO constraint as well as the -CODA constraint. Therefore, he refers to generalised alignment constraints introduced by McCarthy & Prince (1993). He observes that the generalized alignment constraints can possibly eliminate the wrong candidate [nah.r**i**] from being an optimal output since its right edge does not align with the right edge of the input /nah**r**/. In the next tableau, the candidates [na.har], [nah.ri], and [nahr] will be evaluated with the ALIGN-RIGHT constraint.

(3.16) ALIGN-RIGHT>>SSP>>DEP-IO

/nahr/	ALIGN-RIGHT	SSP	DEP-IO
a. nahr		*!	
☞ b. na.har			*
c. nah.ri	*!		*

The tableau (3.16) could eliminate candidate (c) from being an optimal output due to the violation of ALIGN-RIGHT, since the right peripheral segment in this candidate does not align with the right edge of the input, compared to candidates (a) and (b). Candidate (a) violates the SSP due to the final consonant cluster; therefore, it has been eliminated from being an optimal output. As a result, candidate (b) is the optimal output, because it does not violate highly-ranked constraints.

Gouskova & Hall (2009) do a phonetic study on final consonant clusters in Lebanese Arabic. They demonstrate that vowel epenthesis is motivated by the violation of the SSP in Lebanese Arabic. They concentrate on final consonant clusters since this dialect allows no complex onsets as some modern Arabic dialects do. Final consonant clusters which consist of obstruent plus sonorant motivate vowel epenthesis. This means that these clusters do not conform to the SSP due to the peripheral segments being more sonorous than preceding segments, as in (3.17):

(3.17) Final consonant clusters against the SSP: epenthesis required (Gouskova & Hall 2009:4):

a) /mitl/→ [mí.t**i̲**l] ‘like’ (preposition)

b) /nidr/→ [ní.d**i̲**r] ‘low’

c) /ʔibn/→ [ʔí.b**i̲**n] ‘son’

d) /ʒisr/→ [ʒí.s**i̲**r] ‘bridge’

e) /ʔifl/→ [ʔí.f**i̲**l] ‘lock’

f) /ʔism/→ [ʔí.s**i̲**m] ‘name’

g) /naml/→ [ná.m**i**l] ‘ants’

h) /rikb/ → [rí.k**i**b] ‘riding’

i) /rakdˤ/→ [rá.k**i**dˤ] ‘running’[25]

The final consonant clusters in the words in (3.17) violate the SSP due to peripheral segments being more sonorous than the preceding segments (Reverse Sonority). As a result, vowel epenthesis occurs in order to avoid this manner of the SSP violation. The identity of epenthetic vowels in this dialect is similar to MHA (Jarrah 1993), NA (Ingham 1994) and UHA (Al-Mohanna 1998). The epenthetic vowel [i] is identical to the stem vowel /i/ in the ouputs (a), (b), (c), (d), (e), (f), (h) in (3.17), while the same epenthetic vowel in the output [ná.m**i**l] is determined by the identity of the members of the final consonant cluster; therefore, the first member is other than a [+pharyngeal] consonant and the second member is a lateral /l/. This idea has discussed previously by Jarrah (1993) in (3.12) with reference to MHA.

Rakhieh (2009) recognizes the relation between sonority and syllable structure in Ma'ani Arabic; he states that final consonant clusters in this dialect which do not conform to the SSP are avoided by vowel epenthesis.

(3.18) Final consonant clusters in Ma'ani Arabic against the SSP

a) /ʔa**bd**/→ [ʔa.b**i**d] ‘slave’

b) /ti**bn**/→ [ti.b**i**n] ‘hey’

c) /ga**bl**/→ [ga.b**i**l] ‘before’

d) /ʤi**sm**/→ [ʤi.s**i**m] ‘body’

e) /bi**kr**/→ [bi.k**i**r] ‘first baby’

f) /ħa**fr**/→ [ħa.f**i**r] ‘digging’

g) /ma**hr**/→ [ma.h**i**r] ‘dowry’

[25] Gouskova & Hall (2009) state that some speakers insert an epenthetic vowel in the word /rakdˤ/ to become [rá.k**i**dˤ], whereas others produce the same word without inserting an epenthetic vowel in the final consonant cluster, even though this cluster does not conform to the SSP due to the peripheral segment, as an emphatic alveolar voiced stop, is more sonorous than the preceding segment, as an alveolar stop voiceless stop. Parker (2008) presents a sonority scale in which voiced stops are more sonorous than voiceless stops.

h) /ħi**ml**/→ [ħi.m**i**l] ‘load’

i) /fa**rm**/→ [fa.r**i**m] ‘mincing’

j) /ʕadl/→ [ʕa.d**i**l] ‘justice’

The final consonant clusters in the words in (3.18) represent Reverse Sonority as one of the manners of the SSP violation, as mentioned above. Rakhieh (2009) notes that peripheral segments are more sonorous than preceding segments, therefore, it is necessary to break up these final consonant clusters by an epenthetic vowel in order to conform to the SSP. He also accounts for this behaviour using OT; he evaluates the candidates of the input /ʕadl/ ‘justice’ using a set of constraints which includes SONSEQ, MAX-IO, ALIGN, DEP-IO, and *COMPLEX$_{COD}$. Consider the following tableau:

(3.19) SONSEQ>>MAX-IO>>ALIGN>>DEP-IO>>*COMPLEX$_{COD}$

/ʕadl/	SONSEQ	MAX-IO	ALIGN	DEP-IO	*COMPLEX$_{COD}$
☞ a. ʕa.d**i**l				*	
b. ʕadl	*!				*
c. ʕad.li			*!	*	
d. ʕad		*!	*		

The tableau above has determined that candidate (a), which is the desired output, as an optimal output since it has no violation of highly-ranked constraints, even though it violates DEP-IO as a low-ranked constraint. However, candidate (b) has been eliminated from being an optimal output, even though it is the most identical candidate to the input. This candidate violates SONSEQ due to the fact that the peripheral segment in the final consonant cluster, as a liquid, is more sonorous than a preceding segment, as a voiced stop consonant. Candidate (c) could avoid the violation of the SSP by inserting an epenthetic vowel peripherally; therefore, the second member of the final consonant cluster has been resyllabified as an onset of the following syllable in which the epenthetic vowel /i/ is employed as its nucleus. However, the candidate could not avoid the violation of ALIGN due to the peripheral segment not being aligned with the left edge of the input; e.g., /ʕad**l**/→ [ʕad.l**i**]. Candidate (d) could also avoid the violation of SONSEQ due to the deletion of the peripheral segment, but it could not avoid the violation of MAX-IO and ALIGN. Like candidate (c), the left edge of candidate (d) is not aligned with the left edge of the input; hence, the left edge of this output is /d/, whereas the left edge of the input is [l]. As a result, this candidate cannot be an optimal output in any way.

According to Ibrahim (2012), in Kuwaiti and Iraqi Arabic, final consonant clusters that do not conform to the SSP motivate vowel epenthesis, as in (3.20):

(3.20) Final consonant clusters in Kuwaiti and Iraqi Arabic against the SSP

Input	Kuwaiti output	Input	Iraqi output
/ħa**dr**/ 'under'	[ħa.d**i**r]	/ku**br**/ 'size'	[ku.b**u**r]
/sˤa**br**/ 'patience'	[sˤa.b**u**r]	/ʃu**ɣl**/ 'work'	[ʃu.ɣ**u**l]
/ħi**sn**/ 'beauty'	[ħi.s**i**n]	/ha**ðˤm**/ 'digestion'	[ha.ðˤ**u**m]
/ragm/ 'number'	[ra.g**u**m]	/dihn/ 'oil'	[di.h**i**n]
/badr/'full moon'	[ba.d**i**r]	/miθl/ 'like'	[mi.θ**i**l]
/badw/ 'Bedouin'	[bad**u**w]	/wazn/ 'weight'	[wa.z**i**n]

Final consonant clusters that do not obey the SSP are banned from Kuwaiti and Iraqi Arabic. The manner of the SSP violation found in these clusters is Reverse Sonority due to peripherals being more sonorous than preceding consonants. For example, the word /ħa**dr**/ in Kuwaiti Arabic has a peripheral sonorous consonant that precedes an obstruent consonant. As a result, sonority rises again in the coda position. Therefore, it is necessary to split this cluster by an epenthetic vowel in order to satisfy the SSP.

To conclude, Reverse Sonority, which is constituted by a peripheral being more sonorous than a consonant closer to the nucleus in a coda position, motivates vowel epenthesis in most modern Arabic dialects unless vowel epenthesis leads to lexical homonymy, as in the case in MHA (Jarrah 1993). Complexity in the onset position, as a motivating factor for vowel epenthesis, is addressed in the next subsection.

3.2.2 Complexity in the onset position

Abboud (1979), Al-Mohanna (1998), Kiparsky (2003), Haddad (2005), Watson (2007), and Rakhieh (2009) among others state that complex onsets are prohibited in most varieties of Arabic. Word-initial clusters found in verbs derived from binyans of the forms VII /nfaʕal/, VIII /ftaʕal/, and X /stafʕal/ motivate prosthesis, according to Abboud (1979) and Al-Mohanna (1998). This phonological process results from initial consonant clusters in some imperative forms (Abboud 1979; Haddad 2005; Rakhieh). An initial geminate that results from the assimilation of a prefix with the onset of the following syllable motivates prosthesis (Kiparsky & Watson 2007). The first motivating factor is discussed next.

3.2.2.1 Word-initial Clusters in Binyan forms

Binyans or triliteral verbs are verb forms that contain three radical letters (Wright & Caspari 2011). According to McCarthy (1981), by looking at the form /nfaʕal/, the triliteral root is f-ʕ-l, while n- is an affixal root. Additionally, in the form /stafʕal/, the affixal root is st-, while the triliteral root is f-ʕ-l. The triliteral root in the form /ftafʕal/ is f-ʕ-l, while -t- is infix. Two studies below show how word-initial clusters found in verbs derived from the forms VII /nfaʕal/, VIII /ftaʕal/, and X /stafʕal/ result in prosthesis.

Abboud (1979) focuses on verbs in Northern Najdi Arabic. He sheds light on how some verbs in this dialect motivate prosthesis. He states that triliteral verbs such as VII /nfaʕal/, and VIII /ftaʕal/ have initial bi-consonantal clusters which motivate prosthesis; initial epenthesis consists of an epenthetic vowel followed by a glottal stop to avoid an onsetless syllable. Therefore, verbs which are derived from these triliterals permit prosthesis appear as in (3.21):

(3.21) Prosthesis in the perfect forms VII and VIII

a) /nkisar/→ [**ʔi**nkisar] ‘got broken’

b) /ktitab/ → [**ʔi**ktitab] ‘got registered’

It is clear from the verbs above that prosthesis is provoked by certain types of initial bi-consonantal clusters that are not permitted in some modern Arabic dialects in general and in Northern Najdi Arabic in particular. Nasal plus obstruent and stop plus stop clusters are not permitted in this dialect. Therefore, prosthesis is a solution to avoid these types of consonant clusters. This idea is also discussed by Broselow (1983; 1992; 1993). Like the perfect form VII and VIII, Abboud (1979) observes that the perfect form X motivates prosthesis, as in (3.22):

(3.22)

a. /stagal/ → [**ʔí**stagal] ‘he received’

b. /staʕad/→ [**ʔí**staʕad] ‘he became ready’

c. /staʕmal/→ [**ʔí**staʕmal] ‘he used or consumed’

According to Al-Mohanna (1998), complex onsets in UHA result in prosthesis. He observes that some binyans (triliteral verbs) which are introduced by McCarthy (1979a, 1980) motivate prosthesis such as VII /nfaʕal/, VIII /ftaʕal/, and X /stafʕal/, as in (3.23) below drawn from (Al-Mohanna 1998: 104):

(3.23)

Binyan	Perfective Active	
a. VII	/**nk**atab/	→ [ʔin.ka.tab] ‘was written’
b. VIII	/**kt**atab/	→ [ʔik.ta.tab] ‘be registered’
c. X	/**st**aktab/	→ [ʔis.tak.tab] ‘cause to write’

(Al-Mohanna 1998: 104)

The left most segments in the verbs in (3.23) are not affiliated to a syllable node. These segments are considered to be extrasyllables since they are not parsed into the onset position, according to Broselow (1992), Kenstowicz (1986, 1994:297), Watson (2002), and Kiparsky (2003). Al-Mohanna (1998) observes that affiliating left most segments in verbs is challenging. In addition, it might be useful to insert a vowel internally or initially because both types of insertion can achieve the same purpose which is affiliating these segments into a syllable node. For this reason, he refers to McCarthy & Prince (1993a) who recommend a contiguity constraint if there is a cross-linguistic bias against medial epenthesis, especially in this case. McCarthy & Prince (1995: 108) present O-CONTIG which disfavors medial or internal epenthesis. Al-Mohanna (1998) observes that this constraint is also supported by Kenstowicz (1994a) and Spencer (1994) who studied syllabification in Chuckchee. To show the importance of this constraint, Al-Mohanna (1998) evaluates the candidates of the input /ktatab/, using a set of constraints that involves O-CONTIG which is re-ranked higher than DEP-IO.

(3.24) ONS>>*COMPLEX>>MAX-IO>>O-CONTG>>DEP-IO>>NO-CODA

/ktatab/	ONS	*COMPLEX	MAX-IO	O-CONTG	DEP-IO	NO-CODA
a. kta.tab		*!				*
b. k**i**.ta.tab				*!	*	*
c. ta.tab			*!			*
d. ik.ta.tab	*!				*	**
☞ e. ʔik.ta.tab					**	**

The tableau (3.24) shows the importance of using O-CONTIG which could distinguish the desired output (e) as the optimal candidate of the input /ktatab/. This constraint also eliminates candidate (b), which is considered to be a possible syllabification in UHA, from being an optimal output due to an internal epenthetic vowel. On the other hand, other candidates violate highly-ranked constraints. Candidate (a) violates *COMPLEX due to an initial bi-consonantal cluster, whereas candidate (c) violates MAX-IO because of the deletion of the leftmost segment in order to avoid violating *COMPLEX. Unlike candidates (a) and (c), the output (d) is an onsetless candidate due to its lack of onset. Therefore, it violates the most highly-ranked constraint ONS.

3.2.2.2 Word-initial Clusters in Some Imperative Forms

The underlying structure of the imperative form (I) in Arabic is of the canonical shape /CCVC/: i.e. /fʕal/. A prosthetic /i/ is inserted to avoid this cluster and a glottal stop /ʔ/ is inserted before the prosthetic /i/ in order to avoid an onsetless syllable: i.e. [ʔifʕal]. The three studies below show how word-initial clusters in verbs derived from the imperative form (I) are avoided by prosthesis.

Abboud (1979) observes in his study on verbs in Northern Najdi Arabic that not only the perfect forms VII, VIII, and V motivate prosthesis but also word-initial clusters in verbs derived from the imperative form (I) motivate prosthesis:

(3.25) The Imperative form (I) in Northern Najdi Arabic (Abboud 1979)

a) /skin/→ [**ʔi**skin] ‘dwell! (m.s.)’

b) /gtˤaʕ/→ [**ʔi**gtˤaʕ] ‘cut! (m.s.)’

c) /hʤim/→ [**ʔi**hʤim] ‘attack! (m.s.)’

The imperative forms above motivate prosthesis due to initial bi-consonantal clusters that are not permitted in this dialect in particular.

Haddad (2005) discusses the case in which prosthesis results from word-initial clusters in verbs derived from the imperative form (I) with reference to CA. Consider the following examples:

(3.26) a. /ʃrab/→ [**ʔi**ʃ.rab] 'Drink! (m.s.)'

b. /drus/→[**ʔu**d.rus] 'Study! (m.s.)'

c. /qraʔ/→ [**ʔi**q.raʔ] 'Read! (m.s.)'

d. /ktub/→ [**ʔu**k.tub] 'Write! (m.s.)'

Rakhieh (2009) examines the initial epenthesis that is found in the imperative form (I) in Ma'ani Arabic. Brame (1970), Benmamoum (1996), and Al-Shboul (2007) have argued that this form was derived from the imperfective form.[26]

Table 3.1 Imperative forms in Ma'ani Arabic

Imperfective	Meaning	Imperative	Meaning
a. ji-ftaħ	'he opens'	**ʔi**f.taħ	'Open! (m.s.)'
b. ju-drus	'he studies'	**ʔu**d.rus	'Study! (m.s.)'
c. ji-ʃrab	'he drinks'	**ʔi**-ʃrab	'Drink! (m.s.)'

There are three main points regarding the data in table (3.1): firstly, Rakhieh (2009) states that the imperative form is revealed through deletion of the imperfective markers /ji/ and /ju/. In other words, the deletion of the imperfective marker shows how imperatives are derived from the imperfective forms. Secondly, in (3.1b), prosthesis /u/ is determined by the stem vowel /u/ due to vowel harmony; e.g., [ju-drus]/ * [ja-drus] or *[ji-drus]. Finally, the prosthesis /i/ is attached to stems that: a) have complex onsets, and b) are monomoraic; e.g., [ji-**ft**aħ] and [ji-**ʃr**ab]. In fact, scholars including McCarthy and Prince (1990b:9-18), Kiparsky (2000:357), and Watson (2002:233) agree that the vowel /i/ in the imperative is a prosthesis vowel that occurs before a consonant cluster. Reluctantly, Angoujard (1990:125) argues that the vowel /i/ in the imperative has the

[26] This idea is supported by Haddad (2005) who notes that prosthesis is provoked by some cases of imperative verbs in CA.

status of morphological marker rather than a prosthesis vowel. Rakhieh (2009) agrees that the vowel /i/ in the imperative is a prosthesis vowel. He accounts for prosthesis in this dialect using OT. He evaluates the candidates of the input /zraʕ/ using a set of constraints that includes ONS, FtBin, MAX-IO, CONTIGUITY-IO, and DEP-IO.

(3.27) FtBin (Kager 2010:156)

Feet are binary under moraic or syllabic analysis.

(3.28)

/zraʕ/	FtBin	ONS	MAX-IO	CONTIGUITY-IO	DEP-IO
☞ a. ('ʔiz).raʕ					**
b. ('iz).raʕ		*!			*
c. ('zraʕ)	*!				
d. ('raʕ)	*!		*		
e. ('zi.raʕ)				*!	*
f. ('zaʕ)	*!		*		

The tableau above has identified the desired output (a) as an optimal candidate due to its avoidance of the violation of highly-ranked constraints, compared with other candidates. Candidate (e) which is considered to be the closest opponent of the desired output has been eliminated from being an optimal output because it violates CONTIGUITY-IO. Candidates (c), (d), and (f) are not optimised since they violate FtBin. Ultimately, Rakhieh (2009) crucially shows how OT is capable of accounting for initial epenthesis (prosthesis). However, prosthesis is not the only type of epenthesis found cross-linguistically. There is medial or internal epenthesis which is motivated by factors that are illustrated by previous studies, as discussed below.

3.2.2.3 Initial Geminates

Initial geminates result from two processes; the first process is particular to the deletion of a vowel in the prefix in order to permit assimilation of a prefix to an onset as the second process. The reason for this assimilation is to avoid the violation of OCP (Obligatory Contour Principle) with reference to Libyan Arabic dialects (Harrama 1993, and Elramli 2012).Kiparsky (2003) and Watson (2007) observe that initial geminates which result from assimilation are avoided in some modern Arabic dialects through prosthesis; e.g., /l-ʧa:j/→ [ʧʧa:j] ≈ [ʔiʧʧa:j] ‘the tea’.[27]

To conclude, prosthesis is used to avoid word-initial clusters in most modern Arabic dialects since this type of clusters is not common in these dialects, compared with word-final clusters. Initial consonant clusters found in the triliteral verbs, VII /nfaʕal/, VIII /ftaʕal/, and X /stafʕal/, motivate prosthesis. Likewise, initial consonant clusters in some imperative forms in CA and in modern Arabic dialects provoke prosthesis. Initial geminates might be tolerated by some modern Arabic dialects while other dialects avoid this type of geminate by prosthesis. However, this type of epenthesis is no longer motivated by non-final superheavy syllables, whereas these syllables are avoided by internal epenthesis. This behaviour is discussed in detail in the next subsection.

3.2.3 Non-final superheavy syllables

Scholars including Bakalla (1973), Broselow (1976, 1980), Al-Mozainy (1981), McCarthy (1981), Irshied (1984), Itô (1986, 1989), Abu-Mansour (1987), Al-Mohanna (1998), Kiparsky (2003), Watson (2007), and Bamakhramah (2009) note that there is a restriction on the position of superheavy syllables of the forms CVVC and CVCC; consequently, these syllables can be found in the word-final position only where the last consonant is weightless (Bamakhramah 2009:107). As discussed in subsection 2.5.2, Kiparsky (2003) and Watson (2007) state that there is a different treatment of the semisyllables in /CVV.$\underline{\mathbf{C}_\mu}$.CV and /CVC.$\underline{\mathbf{C}_\mu}$.CV/among modern Arabic dialects. This leads Kiparsky (2003) and Watson (2007) to classify modern Arabic dialects into three groups, depending on the treatment of semisyllables: C-dialects, CV-dialects, and VC-dialects. Non-final CVVC and CVCC that are associated with consonant-initial affixes might be tolerated in some modern Arabic dialects by mora sharing rather than vowel epenthesis, while other dialects permit vowel epenthesis to avoid these syllables instead of mora sharing. To understand these phenomena, some previous studies below show the different treatments of non-final CVVC and CVCC.

Bakalla (1973) accounts for the phonology and morphology of Meccan Arabic. He demonstrates vowel epenthesis in this dialect and the motivators for this phonological process. He states that vowel epenthesis in this dialect is not only motivated by having sonorous peripherals in the final consonant clusters, but it is also motivated by having

[27] Gafos (2003) states that onset positions are not filled with geminates in Arabic.

the non-final superheavy syllables such as CVVC and CVCC, especially when these syllables are associated with consonant-initial affixes, as in (3.29) below:

(3.29) Epenthesis and non-final superheavy syllables in Meccan Arabic

a) /ʕi.**rift**-hum/→[ʕi.rif.t**a**.hum] ‘I knew them’ (CV.CVCC.CVC→CV.CVC.C**v**.CVC)
b) /χa.**rabt**.ha/→[χa.rab.t**a**.ha] ‘you spoil it (f.s.)’ (CV.CVCC.CV→CV.CVC.C**v**.CV)
c) /ʃa:f.ha/→[ʃaa.f**a**.ha] ‘he saw her’ (CVVC.CV→CVV.C**v**.CV)

He observes that internal epenthesis in Meccan Arabic is motivated by having non-final superheavy syllables in the forms CVVC and CVCC when these syllables are associated with consonant-initial suffixes. For instance, the verbs in (3.29 a-b) have non-final superheavy syllables of the form CVCC associated with consonant-initial suffixes such as /-hum/ and /-ha/. As a result, vowel epenthesis is permitted in order to avoid having these syllables in the non-final position. That is to say that non-final superheavy syllables are not permitted in some modern Arabic dialects in general and in Meccan Arabic in particular, especially when these syllables are suffixed with initial consonant affixes. Vowel epenthesis is a solution to avoid this type of syllables in the non-final position. As a result, these superheavy syllables become heavy since their final consonants have been resyllabified as onsets of the following syllables. However, he notes that vowel epenthesis is not necessarily the case when superheavy syllables are associated with vowel-initial suffixes, as in (3.30):

(3.30) Non-final superheavy syllables and vowel-initial affix in Meccan Arabic

a) /ʃa:f-ak/→ [ʃa:.fak] ‘he saw you’ (CVV.CVC)

b) /ʃa:f-u/→[ʃa:.fu] ‘they saw’ (CVV.CV)

Bakalla (1973) believes that this case excludes vowel epenthesis as long as non-final superheavy syllables are associated with vowel-initial affixes because the last segment, or more precisely, a coda, will be resyllabified as an onset of the following syllable, as in (3.30) above. He also states that final superheavy syllables do not demand vowel epenthesis in this dialect in particular; e.g., /tiʃ.ta.**ri:h**/→ [tiʃ.ta.ri:h] ‘you buys it (m.s.)’. This idea demonstrates that final superheavy syllables do not result in vowel epenthesis, whereas non-final superheavy syllables which are suffixed with consonant-initial affixes motivate vowel epenthesis in some modern Arabic dialects in general. This idea has been scrutinised by other Arabic scholars such as Broselow (1976; 1980), Al-Mozainy (1981), McCarthy (1981), Itô (1986; 1989), Kenstowicz (1986), Abu-Mansour (1987), Al-Mohanna (1998), Kiparsky (2003), and Watson (2007).

Abu-Mansour (1987) adheres to Bakalla's (1973) analysis of phonology and morphology of Meccan Arabic. She states that non-final superheavy syllables of the form CVCC which are suffixed with consonant-initial affixes are mostly banned from most modern Arabic dialects, including Meccan Arabic. Therefore, vowel epenthesis is permitted to avoid having non-final superheavy syllables, as in (3.31):

(3.31) Non-final superheavy syllables CVCC and epenthesis in Meccan Arabic

a) /ħusn-ha/→ [ħus.n**a**.ha] 'her beauty'

b) /ʕitˤr-ha/→ [ʕitˤ.r**a**.ha] 'her perfume'

c) /ʔism-ha/→ [ʔis.m**a**.ha] 'her name'

She also states that prepausal epenthesis is conditioned by the violation of the SSP. In other words, this type of epenthesis is triggered by a tautosyllabic consonant cluster that violates the SSP:

(3.32)

I) Prepausal Epenthesis:

a) /ħusn/→ [ħu.s**u**n] 'beauty'

b) /ʕitˤr/→ [ʕitˤ**i**r] 'perfume'

c) /ʔism/→ [ʔi.s**i**m] 'name'

d) /ʃuɣl/→ [ʃu.ɣ**u**l] 'work'

II) General Epenthesis:

a) /ħusn-ha/→ [ħus.n**a**.ha] /* [ħus**u**.n**a**.ha] 'her beauty'

b) /ħusn-i/→ [ħusn-i] /*[ħu.su.ni] 'my beauty'

c) /ʕitˤr-ha/→ [ʕitˤ.r**a**.ha]/ *[ʕi.tˤ**i**.r**a**.ha] 'her perfume'

d) /ʕitˤr-u/→ [ʕitˤ.ru] /*[ʕi.tˤ**i**.ru] 'his perfume'

e) /ʔism-ha/→ [ʔis.ma.ha]/*[ʔisimaha] 'her name'

f) /ʔism-i/→[ʔis.mi] /* [ʔi.s**i**.mi] 'my name'

g) /ʃuɣl-ha/→ [ʃuɣ.l**a**.ha] /*[ʃu.ɣ**u**.l**a**.ha] 'her work'

h) /ʃuɣl-i/→ [ʃuɣ.li]/* [ʃu.ɣu.li] 'my work'

She notes that prepausal epenthesis (3.32-I) results from a final consonant cluster that violates the SSP; consequently, this cluster is broken up by internal epenthesis. In other words, this type of epenthesis is conditioned by sonority violation: i.e. CVCC→ CV.C**V**C. In this dialect, general epenthesis in (3.32-II) is not conditioned by the violation of sonority due to the attachment to consonant-initial suffixes; e.g. /ħusn-ha/→ [ħus.n**a**.ha] /*[ħus**u**n.ha]. Unlike Meccan Arabic, in other modern Arabic dialects, prepausal epenthesis is triggered by the violation of the sonority found in the final consonant cluster in non-final CVCC that is associated with a consonant-initial suffix. For instance, Irshied (1984:60), who examines the phonology of Bani-Hassan, observes that prepausal epenthesis is motivated by the final consonant cluster in the CVCC syllable which violates the SSP. This type of epenthesis also results from the same syllable in the non-final position when associating with a consonant-initial suffix; e.g. /haʤr-na/→ [ha.ʤ**a**r.na] 'we deserted'. However, general epenthesis is not conditioned by the violation of the SSP if the final consonant cluster in a non-final CVCC conforms to the SSP, whereas it occurs after the consonant cluster when associating a consonant-initial suffix; e.g., /jin.s_{μ}.ħib/→ [jin.s**i**.ħib] 'to be pulled'.

Broselow (1976; 1980) sought the reason for epenthesis in Cairene and Iraqi Arabic in tri-consonantal clusters. She observes that non-final superheavy syllable of the form CVCC motivates vowel epenthesis in both dialects, especially when these syllables are preceded by a unity of dative plus initial vowel or initial consonant affixes; nonetheless, the places of vowel epenthesis are different in both dialects. For instance, vowel epenthesis in Cairene Arabic occurs between the second and the third member of medial tri-consonantal clusters, whereas it occurs between the first and the second member of medial tri-consonantal clusters in Iraqi Arabic, as in (3.33):

(3.33) a. Cairene “I said to him”

/ʔult-l-u/→ [ʔul.t**i**.lu]

b. Iraqi “I said to him”

/gilt-l-a/→ [gi.l**i**t.la]

Complex syllable margins are not permitted in either dialect; therefore, this complexity has been split by vowel epenthesis, but Cairene and Iraqi Arabic deal with the occurrence of an epenthetic vowel differently. For instance, vowel epenthesis in Cairene Arabic occurs between the second and third member of a medial tri-consonantal cluster. As a result, the second member becomes an onset of the following syllable in which the epenthetic vowel is employed as its nucleus. On the other hand, vowel epenthesis in Iraqi Arabic occurs between the first and second member of a medial tri-consonantal cluster which results in the resyllabification of the first and the second member of this cluster. The first member becomes an onset of a newly-internal syllable, and the second member becomes a coda of the same syllable. This idea is related to McCarthy’s (1981) and Itô’s (1986; 1989) work regarding the syllable template in both dialects being a motivator for internal epenthesis. McCarthy (1981) and Itô (1986, 1989) examined the example “I said to him” in Cairene and Iraqi Arabic as presented by Broselow (1976; 1980). They observe that the syllable template in both dialects is [CVC] as well as in other dialects. This template is considered to be the maximal syllable structure that both dialects permit. Accordingly, the non-final superheavy syllable CVCC in Cairene and Iraqi input does not conform to the syllable template. Therefore, it is necessary to insert a vowel to break the final consonant cluster in this syllable in both dialects; e.g., /ʔu**lt**.l.u/ → [ʔul.t**i**.lu] and /gilt.l.a/ → [gi.l**i**t.la]. McCarthy (1981) and Itô (1986; 1989) state that Cairene and Iraqi outputs conform to the syllable template [CVC] due to vowel epenthesis, but they observe that the syllable template is mapped differently in both dialects. The syllable template is mapped from left to right in Cairene, and in Iraqi Arabic from right to left, due to different places of vowel epenthesis, as in (3.34):

(3.34)

a. Syllable template mapping in Cairene Arabic (left → right)

```
ʔ u l   t i   l u
| | |   | |   | |
C V C   C V   C V
```

Mapping: →→→→→

b. Syllable template mapping in Iraqi Arabic (right → left)

```
g i   l i t   l a
| |   | | |   | |
C V   C V C   C V
```

Mapping: ←←←←

Al-Mohanna (1998) accounts for epenthesis that is motivated by medial tri-consonantal and quadric-consonantal clusters in UHA using OT. Firstly, he evaluates the candidate of the input /bi**nt**+**k**um/ which has a medial tri-consonantal cluster. He refers to a set of ranking constraints that include NUC, *P/C, *M/V, *COMPLEX, ONS, SYL-MAX, O-CONTIG, DEP-IO, SYL-MIN, S-ALIGN(R), and -CODA. Some of these constraints were illustrated in studies discussed above, and the others are illustrated in (3.35) below:

(3.35)

a. NUC (Prince & Smolensky 1993):

Syllables must have nuclei.

b. Syllable Maximality (SYL-MAX) (Al-Mohanna 1998:100):

Syllables are maximally bi-moraic.

c. Syllable Minimality(SYL-MIN) (Al-Mohanna 1998:100):

Syllables are minimally bi-moraic.

d. *P/C (Prince & Smolensky 1993):

C may not associate to peak nodes. (C stands for a consonant)

e. *M/V (Prince and Smolensky 1993):

V may not associate to margin nodes (onsets and codas) (V stands for a vowel).

(3.36)

/bint+kum/	NUC,*P/C,*M/V,* COMPLEX, ONS, SYL-MAX	MAX-IO	O-CONTIG	DEP-IO	SYL-MIN	-CODA
a. bin.t**a**.kum			*	*	*	**
b. bi.n**a**t.kum			*	*	*	**
c. bint.kum	*!*COMPLEX *SYL-MAX					**
d. bin.kum		*!				**

Al-Mohanna (1998) observes that the tableau above identifies both candidates (a) and (b) as optimal outputs, whereas the purposes of the tableau (3.36) is to distinguish the desired candidate analysis (a) as an optimal output of the input /bint+kum/ and to eliminate the wrong output (b) from being optimal. Al-Mohanna (1998) resolves this case by referring to a member of a family alignment of constraints introduced by Mester and Padgett (1994), as in (3.37) below:

(3.37)

a. Syll-ALIGN (L): Align (Syll, L, PrWd, L) (Cited from Al-Mohanna 1998:115):

Every syllable must be left-edge aligned with the left edge of the prosodic word.

b. Syll-ALIGN (R): Align (Syll, R, PrWd, R) (Cited from Al-Mohanna 1998:115):

Every syllable must be right-edge aligned with the right edge of the prosodic word.

The constraint (3.37a) above is violated by outputs that have more moras that separate the left edge of these outputs from the left edge of the prosodic word, and vice versa in the constraint (3.37b). The wrong output violates Syll-ALIGN (R) due to the number of moras that separate its left edge from the left edge of the prosodic word. In order to investigate this, consider the following tableau:

(3.38)

/bint+kum/	NUC,*P/C,*M/V,* COMPLEX, ONS, SYL-MAX	MAX-IO	O-CONTIG	DEP-IO	SYL-MIN	Syll-ALIGN (R)	-CODA
☞a.bin.t**a**.kum			*	*	*	3µ	**
b. bi.n**a**t.kum			*	*	*	4µ!	**
c. bint.kum	*!*COMPLEX *SYL-MAX					1µ	**
d. bin.kum		*!				1µ	**

Syll-ALIGN (R) could distinguish the desired output (a) as an optimal output and eliminate the wrong output (b) from being an optimal candidate analysis due to the number of moras that separate its right edge from the right edge of the prosodic word. The wrong output (b) has four moras that separate its right edge from the right edge of the prosodic word, compared to the number of moras in the desired output (a). The tableau below illustrates how the numbers of moras are counted from the left to right edge:

(3.39)

	Syll-ALIGN (R)			
/bint+kum/	S_1	S_2	S_3	Total moras
a. $bi_{\mu}n_{\mu}.t\underline{\mathbf{a}}_{\mu}.ku_{\mu}m$	Ø	µ	µµ	3
b. $bi_{\mu}.n\underline{\mathbf{a}}_{\mu}t_{\mu}.ku_{\mu}m$	Ø	µ	µµµ	4
c. $bin_{\mu}t_{\mu}.ku_{\mu}m$	Ø	µ	Ø	1
d. $bi_{\mu}n_{\mu}.ku_{\mu}m$	Ø	µ	Ø	1

To sum up, this constraint is considered to be an ad hoc solution to the problem related to determining candidate (a) as an optimal output, according to Al-Mohanna (1998). However, what would be the case in which epenthesis results from quadri-consonantal clusters? Is it possible to use the same set of constraints in (3.37) and (4.38) to determine the desired output [ka.tab.t**a**l.ha] of the input /katab+t+l+ha/ ‘I wrote to her’? This question has been addressed by Al-Mohanna (1998) who evaluates the candidates of the input /katab+t+l+ha/ by using a set of ranking constraints in (3.37) and (3.38). Consider the following tableau:

(3.40)

/katab+t+l+ha/	NUC,*P/C,* M/V,*COMP LEX, ONS, SYL-MAX	MAX-IO	O-CONTIG	DEP-IO	SYL-MIN	Syll-ALIGN (R)	-CODA
☞a. ka.tab.t**a**l.ha			*	*	**	9μ	**
b.ka.ta.b**a**t.l**a**.ha			**!	*	****	12μ!	*
c. ka.tabt.l**a**.ha	*!*COMPLEX *SYL-MAX		*		***	8μ	*
d. ka.tab.l**a**.ha		*!	*		***	7μ	*

The same set of ranking constraints in (3.40) could determine the desired output (a) as the optimal candidate of the input /katab+t+l+ha/, whereas the wrong output (b) violates O-CONTIG twice, and therefore has been eliminated from being an optimal output. Furthermore, the right edge of this candidate is separated from the right edge of the input by twelve moras, compared to the number of moras in the desired output (a). The tableau below shows the number of moras that separate the left from the right edge:

(3.41)

	Syll-ALIGN (R)					
/katab+t+l+ha/	S_1	S_2	S_3	S_4	S_5	Total moras
a. ka$_{\mu}$.ta$_{\mu}$b$_{\mu}$.t**a**$_{\mu}$l$_{\mu}$.ha$_{\mu}$	Ø	μ	μμμ	μμμμμ	Ø	9
b.ka$_{\mu}$.ta$_{\mu}$.b**a**$_{\mu}$t$_{\mu}$.l**a**$_{\mu}$.ha$_{\mu}$	Ø	μ	μμ	μμμμ	μμμμμ	12
c. ka$_{\mu}$.ta$_{\mu}$b$_{\mu}$t$_{\mu}$.l**a**$_{\mu}$.ha$_{\mu}$	Ø	μ	μμ	μμμμμ	Ø	8
d. ka$_{\mu}$.ta$_{\mu}$b$_{\mu}$.l**a**$_{\mu}$.ha$_{\mu}$	Ø	μ	μμ	μμμμ	Ø	7

The other candidates (c) and (d) have been initially terminated due to their violations of highly-ranked constraints such as *COMPLEX and MAX-IO. The answer to the question posed above is that it is possible to use the same set of constraints in (3.37) and

(3.38) to optimise the desired output [ka.tab.t**a**l.ha], as long as the desired output has been identified as an optimal candidate.

However, I disagree with Al-Mohanna's (1998) argument that medial tri-consonantal and quadri-consonantal clusters motivate vowel epenthesis in UHA, because consonant clusters are found either initially or finally within the same syllable, and there are no known medial consonant clusters. My argument is supported by Malick (1957), Abercrombie (1967), Odisho (1979), Kiparsky (2003), Watson (2007), and Al-Qenaie (2011). Malick (1957), Abercrombie (1967), Odisho (1979), and Al-Qenaie (2011) agree that a consonant cluster is a sequence that is found within a syllable, not within words or across word boundaries. This shows that a medial sequence of consonants is not considered to be a consonant cluster since all members of this sequence are not formed in one syllable. For example, the word /ka.tab.l.ha/ has a medial sequence /b-l-h/ which is not a consonant cluster, because all members of this sequence are not found within a syllable: the first member /b/ belongs to a different syllable, whereas the third member /h/ belongs to another syllable (final syllable). The second member /l/ does not belong to any syllable, because it is a semisyllable.[28] This can be attributed to what has been found by Kiparsky (2003) and Watson (2007). They state semisyllables are moras that are not affiliated to a syllable node. Kiparsky (2003) uses an example of the word that has a semisyllable such as /jik.t_{μ}.bu/ 'they write'. This word has a medial sequence /k-t-b/, but this sequence is not considered to be a consonant cluster since the first and third members belong to different syllables, whereas the second member /t/ stands alone as a semisyllable. Therefore, this semisyllable cannot be affiliated to the preceding syllable; otherwise the preceding syllable would be tri-moraic which is not permitted in modern Arabic dialects, according to Broselow et al. (1997). Watson (2007) adheres to Kiparsky's (2003) classification of dialects and she observes that C dialects permit semisyllables at lexical and postlexical levels, whereas VC dialects allow semisyllables at the lexical level only. Unlike these dialects, CV dialects permit semisyllables at no levels. Therefore, in the C-dialects, the semisyllable /t/ at the lexical level is /$ji_{\mu}k_{\mu}$.t_{μ}.bu_{μ}/ and [$ji_{\mu}k_{\mu}t$.bu_{μ}], whereas the same semisyllable is permitted at the lexical level in VC-dialects only; e.g., word or lexical level→ /$ji_{\mu}k_{\mu}$.t_{μ}.bu_{μ}/, but postlexical

[28] Scholars including Aoun (1979), Selkirk (1981), McCarthy and Prince (1990a, 1990b), Broselow (1992), Farwaneh (1995), Kiparsky (2003), Watson (2007), and Jarrah (2013) used the semisyllable notion in analysing Arabic. This semisyllable is deemed a moraic consonant which is directly linked to the prosodic word rather than the syllable node.

level [$ji_\mu k_\mu.t\underline{\mathbf{i}}_\mu.bu_\mu$]. Unlike C and VC dialects, CV dialects do not permit semisyllables at any levels; e.g., /$ji_\mu k_\mu.ti_\mu.bu_\mu$/→ [$ji_\mu k_\mu.ti_\mu.bu_\mu$]. Kiparsky (2003) accounts for such behaviour using OT. He refers to some constraints such as REDUCE and LICENSE-μ, as shown in (3.42) below:

(3.42)

a) Reduce (Kirchner 1996, McCarthy 1999)

This constraint requires minimizing the duration of light syllables on the scale a>i,u> ø.

b) LICENSE-μ (Kiparsky 2003)

This constraint is against moraic consonants that are unaffiliated to a syllable node.

Having illustrated both constraints in (3.42), it will now be demonstrated how semisyllables in VC dialects are permitted at the postlexical level and permitted at no levels in CV dialects. Consider the following tableaux:

(3.43)

a. VC dialects: lexical or word level

[(yik).(ti.bu)]	Reduce	LICENSE-μ
☞ i. (yik) t_μ.bu	*	*
ii. (yik).($t\underline{\mathbf{i}}$.bu)	**!	

b. VC dialects: postlexical level

[(yik).(ti.bu)]	LICENSE-μ	Reduce
i. (yik) t_μ.bu	*!	*
☞ii. (yik).($t\underline{\mathbf{i}}$.bu)		**

(3.44)

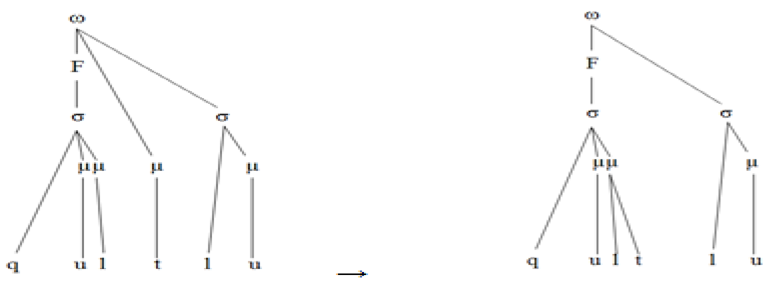
a. CV dialects: word or lexical level

	[(yik).(ti.bu)]	LICENSE-µ	Reduce
	i. (yik) t_{μ}.bu	*!	*
☞	ii. (yik).(t**i̱**.bu)		**

The tableaux above show that a semisyllable is permitted at the lexical level in VC dialects, whereas the same semisyllable is not permitted at the lexical level in CV dialects.

Watson (2007) has a very important argument regarding the semisyllables in C dialects. She states that semisyllables in these dialects share their mora with the preceding syllables in order to avoid having tri-moraic syllables, as in (3.44) (Note that ω stands for a prosodic word, and F stands for a foot):[29]

(3.45)

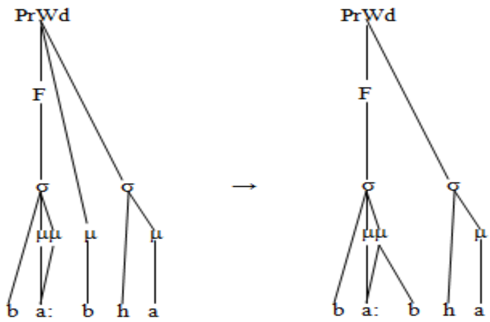


According to the representation of the word /qultlu/ ‘I said to him’ above, she observes that a tri-moraic syllable is avoided by sharing the mora of a semisyllable /t/ with the mora of a preceding segment /t/ in C dialects: i.e. a semisyllable does not exist due to mora sharing. Therefore, /t/ and /l/ belong to one mora instead of having different moras which consequently results in a tri-moraic syllable. This process, which is known as mora sharing, is introduced by Broselow (1992, 1997) and Watson (2007). However, this process cannot be implemented for both VC and CV dialects, especially if a semisyllable is preceded by a non-final closed syllable CVC; indeed, mora sharing is banned from VC dialects if a semisyllable is preceded by a non-final closed syllable

[29] Farwaneh (1995), and McCarthy (2007) reported that a mora can be shared by two consonants if they obey the SSP.

CVC, except if the non-final syllable is an open syllable CVV. A semisyllable can share its mora with a second vowel, as in (3.46) below:

(3.46)



The representation of the word /baa.b$_{\mu}$.ha/ in (3.46) above shows that a semisyllable is affiliated to a syllable node by sharing its mora with the second vowel. Also, vowel epenthesis is not necessary to avoid a tri-moraic syllable, since a preceding syllable has a long vowel. Unlike C and VC dialects, mora sharing is banned from CV dialects, except if the final syllable is CVVC. In some CV dialects, Kiparsky (2003) notes that vowel epenthesis is used to affiliate a semisyllable, which is moraic, of course, to a syllable node rather than sharing its mora with a preceding syllable that has a long vowel. For instance, in Meccan Arabic, Kiparsky (2003) states that a semisyllable can be affiliated to a syllable node by vowel epenthesis, even if the preceding syllable has a long vowel; e.g., /ba:.b$_{\mu}$.ha/→ [ba:.b**a**.ha] 'her door'.

To conclude, non-final supeheavy syllables CVVC and CVCC motivate vowel epenthesis in most modern Arabic dialects, while some dialects can tolerate these CVVC syllables through mora sharing. Some dialects permit non-final CVVC syllables by using mora sharing and vowel epenthesis to avoid non-final CVCC, whereas other dialects avoid these syllables through vowel epenthesis and block mora sharing. Some dialects that permit vowel epenthesis to avoid non-final superheavy syllables are different in the sites of vowel epenthesis; some dialects permit vowel epenthesis after an unsyllabified consonant (CV-dialects) while other dialects allow vowel epenthesis before an unsyllabified consonant (VC-dialects). However, an unsyllabified consonant can affiliate to a syllable node by long vowel shortening rather than vowel epenthesis and mora sharing in other CV dialects; e.g. /ba:.b$_{\mu}$.ha/→ [bab.ha] 'her door' in Cairene and Delta Arabic. This process is illustrated in the next section.

3.3 Previous Research on vowel shortening

Long vowel shortening has been addressed by some scholars including Harrama (1993), Al-Mohanna (1998), and Rakhieh (2009). They state that this process targets the long vowel /a:/ in nouns and hollow verbs. Hollow verbs are verbs of the canonical shape CaaC. They also sought the motivating factors for this process and found that there are three factors responsible: one is morphophonological and is related to the association of a hollow verb with a subject verb agreement suffix; e.g. /g**a:**l+t/ → [gilt] 'I said'. The shortened vowel undergoes the vowel ablaut due to the subject verb agreement suffix (Watson 2002): i.e. /g**a:**l+t/ → /g**a**lt/→ vowel ablaut → [g**i**lt].[30] The process of vowel ablaut is not applied to the second factor which is relevant to the avoidance of an unstressed heavy syllable of the form CVV. The final factor is the avoidance of stress clash. These factors are demonstrated in detail with reference to some modern Arabic dialects like UHA, Ma'ani Arabic, and Al-Jabal dialect in Libya.

Al-Mohanna (1998) examines long vowel shortening in UHA and states that a long vowel /a:/ in hollow verb of the form CVVC is shortened when this verb is associated with a consonant-initial subject agreement suffix. Furthermore, the shortened vowel in this case undergoes vowel ablaut. This statement is shown in the examples in (3.47):

(3.47)

a. /g**a:**l+t_{SUB}/ → [gult] 'I said'

b. /ʤ**a:**b+na_{SUB}/→ [ʤib.na] 'we brought'

c. /ʃ**a:**l+ti_{SUB}/→ [ʃil.ti] 'you (fm. sg.) carried'

d. /s**a:**b+tu_{SUB}/→[sib.tu] 'you (pl.) left'

Likewise, Rakhieh (2009) agrees with Al-Mohanna (1998) regarding the association of a hollow verb with a consonant-initial subject agreement suffix resulting in a long vowel shortening with reference to Ma'ani Arabic; e.g., /ʤa:b-na_{SUB}/→[ʤib.na] 'we brought'. He accounts for this behaviour using OT with some constraints:

[30] Vowel ablaut is known as vowel alternation in which a low vowel /a/ is changed to the vowel /i/.

(3.48)

a. *VVC- (Kiparsky 2003):

Nonfinal long closed syllables or long open syllables which are followed by a moraic consonant are not allowed.

b. MAX-IO$_{V[LONG]}$ (Kenstowicz 1995):
Assign one violation mark for every long vowel that undergoes shortening.

Rakhieh (2009) refers to the constraints in (3.48) in order to evaluate the candidates of the input /ʤa:b-na/:

(3.49)

/ʤa:b-na$_{SUB}$/	*VVC-	MAX-IO$_{V[LONG]}$
☞ a. ʤib.na		*
b. ʤaab.na	*!	

Output (a) is identified in the tableau (3.49) as the optimal candidate of the input /ʤa:b-na/ since it avoids the violation of the *VVC- constraint. Unlike the optimal output, output (b) preserves a long vowel to satisfy the constraint MAX-IO$_{V[LONG]}$ but this satisfaction leads to the violation of the *-VCC- constraint. Therefore, this output is eliminated from being optimal. What if the candidate [ʤab.na] is added to the tableau (3.49)? Would be possible to determine if the candidate [ʤib.na] is optimal? Consider the following tableau.

(3.50)

/ʤa:b-na$_{SUB}$/	*VVC-	MAX-IO$_{V[LONG]}$
a. ʤib.na		*
b. ʤa:b.na	*!	
c. ʤab.na		*

The tableau (3.50) fails to identify the candidate [ʤib.na] as optimal because this candidate and candidate (c) equally violate the MAX-IO$_{V[LONG]}$ constraint. The following constraint can differentiate between the candidates (a) and (c):

(3.51) VOWEL ABLAUT (VA)

The shortened vowel that results from the attachment of a consonant-initial subject agreement suffix should undergo vowel ablaut (vowel alternation).

The constraint in (3.51) will be ranked higher than the MAX-IO$_{V[LONG]}$ constraint in order to identify the candidate [ʤib.na] as optimal.

(3.52)

/ʤa:b-na$_{SUB}$/	*VVC-	VA	MAX-IO$_{V[LONG]}$
☞ a. ʤib.na			*
b. ʤaab.na	*!		
c. ʤab.na		*!	*

With regard to the second motivating factor for long vowel shortening, Harrama (1993) shows that a long vowel in the final syllable results from the deletion of the final glottal stop in the Al-Jabal dialect in Libya, but this long vowel undergoes the shortening process since it is in an unstressed final syllable. This shortening process is illustrated in the examples below:

(3.53)

a. /ħamra:ʔ/→ /ħamra:/→ /ħamra/ ‘red (fm.)’

b. /sama:ʔ/→ /sama:/→ /sama/ ‘sky’

c. /ʕamja:ʔ/→ /ʕamja:/→ /ʕamja/ ‘blind (fm. sg.)’

He formulates this rule of vowel shortening as follows:

(3.54) VV [-stress] →V/______# (Harrama 1993:40)

Applying the final motivating factor for long vowel shortening, Rakhieh (2009) observes that in Ma’ani Arabic a long open syllable, as a penultimate syllable, is targeted by vowel shortening when it is followed by CVVC or CVCC, as an ultimate syllable. Based on stress parameters in Arabic, both syllables, the penultimate and final syllables, are targeted by stress because they possess appropriate properties for stress assignment. A non-final CVV, which is heavy, undergoes vowel shortening to avoid stress clash. He accounts for this behaviour using OT; therefore, he evaluates the candidates of the input /ba:b-i:n/ using OT. He also refers to another constraint which accounts for stress clash; i.e., *CLASH. According to Kager (1999), this constraint prohibits adjacent prominent syllables. Consider the following tableau below:

(3.55)

/ba:b-i:n/	*CLASH	MAX-IO$_{V[LONG]}$
☞ a. ba.(ˈbi:n)		*
b. (ˈba:).(ˈbi:n)	*!	

Output (a) is successfully selected as the optimal candidate analysis of the input /baab-iin/ because this output avoids the violation of the *CLASH constraint by a long vowel shortening in the penultimate syllable. Output (b) is prevented from being optimal due to the violation of the *CLASH constraint.

To conclude, the long vowel /a:/ found in hollow verbs and in some nouns is targeted by long vowel shortening through three factors. The first factor is morphophonological which regards the association of a hollow verb with a subject verb agreement suffix with reference to UHA (Al-Mohanna, 1998) and Ma'ani Arabic (Rakhieh,2009) ; e.g. /g**a:**l+t/ → [gilt] or [gult] 'I said'. The second factor is unquestionably related to the avoidance of an unstressed heavy syllable that results from the deletion of a final glottal stop, according to Harrama (1993); e.g. /ħamra:ʔ/→ /ħamra:/→ /ħamra/ 'red (fm.)'. The final factor is the avoidance of stress clash in light of OT with reference to Ma'ani Arabic (Rakhieh, 2009); e.g., /ba:b-i:n/→long vowel shortening → [ba.ˈbi:n]/*[ˈba:.ˈbi:n]. An examination of previous studies of syncope will take place in the next section.

3.4 Previous studies of syncope

Scholars of Arabic phonology including Al-Mozainy (1981, 1982), Irshied (1984), Abu-Mansour (1987), Harrama (1993), Al-Mohanna (1994, 1998), Sakarna (1999; 2005), Rose (2000), Watson (2002), and Rakhieh (2009) demonstrate the impact of syncope on syllable structure in modern Arabic dialects. This process targets an unstressed high short vowel in a non-final open light syllable which is followed by syllables in the forms CVVC, CVCC, and CVG (G stands for a geminate) with reference to Bedouin Hijazi Arabic (Al-Mozainy 1981), the Al-Jabal dialect in Libya (Harrama 1993), and San'ani Arabic (Watson 2002). Additionally, a short vowel in a light syllable in the antepenultimate position undergoes syncope when the penultimate syllable is light; this behaviour is known as trisyllabic elision, according to Sakarna (1999, 2005) and

Rakhieh (2009). Furthermore, an unstressed short vowel in a light penultimate syllable (VCiCV) that results from the association of form CV.CVC with a vowel-initial affix provokes syncope (Al-Mohanna 1998; Rose 2000; Watson 2002). On the other hand, syncope is blocked when it results in non-final CVCC or in some words that are borrowed from Standard Arabic (Al-Mohanna 1994, 1998; Rakhieh 2009). It applies in the case in which a verb of the form Ca.CaC is associated with a consonant-initial affix (Al-Mohanna 1994). These phenomena are discussed in detail in this section.

Al-Mozainy (1981) accounts for the initial bi-consonantal cluster in Bedouin Hijazi Arabic. This cluster is created by the deletion of an unstressed short vowel in a non-final light open syllable, especially when an open syllable is preceded by a final CVVC or CVCC syllable, as in (3.56) below:

(3.56)

I. a. /ʃu.ˈra:b/ → [ˈʃra:b] ‘leather sack’

b. /ħu.ˈra:g/ → [ˈħra:g] ‘garbage fire’

c. /ku.ˈra:ʕ/ → [ˈkra:ʕ] ‘leg’

d. /gu.ˈra:ʃ/→ [ˈgra:ʃ] ‘cutting wood’

e. /fu.ˈra:ʃ/→ [ˈfraaʃ] ‘duvet’

f. /ʕu.ˈra:ðˤ/→ [ˈʕra:ðˤ] ‘wide’

g. /ru.ˈχu:m/→ [ˈrχu:m] ‘cowards’

h. /ru.ˈgu:m/→ [ˈrgu:m] ‘marks’

i. /gu.ˈru:ʃ/→ [gruuʃ] ‘coins’

h. /gu.ˈru:m/→ [ˈgru:m] ‘warriors’

j. /gu.ˈru:d/→ [ˈgru:d] ‘monkeys’

k. /ʕu.ˈru:g/→ [ˈʕru:g] ‘roots’

l. /ʃu.ˈru:g/→ [ˈʃru:g] ‘men of Najdi origin’

II. a. /ði.ˈra:ʕ/→ [ˈðra:ʕ] ‘an arm’

b. /tˤi.ˈra:ʃ/→ [ˈtˤra:ʃ] ‘vomiting’

c. /sˤi.ˈra:m/→ [ˈsˤra:m] ‘harvest’

d. /ʃi.ˈra:ʕ/→ [ˈʃra:ʕ] ‘tent’

e. /ri.ˈga:b/→[ˈrga:b] ‘necks’

Unstressed high short vowels /i/ and /u/ in non-final open syllables are deleted since these syllables are preceded by final CVVC syllables. For instance, in (3.56-I), the unstressed short vowel /u/ in a non-final light open syllable is deleted when this syllable is followed by the final syllable CVVC. The unstressed /i/ in a non-final light open syllable is also deleted due to the ultimate syllable of the canonical shape CVCC, as in (3.56-II-f).

Likewise, Harrama (1993) observes that an unstressed vowel in a non-final open light syllable undergoes syncope when this syllable is followed by a syllable of the form CVVC or CVG in the Al-Jabal dialect. Consider the following examples:

(3.57)

a. /ji.ˈgu:l/→ [ˈjgu:l] ‘he says’

b. /di.ˈja:r/→ [dyáar] ‘rooms’

c. /ni.ˈgad.dim/→ [ˈngad.dim] ‘I offer’

d. /ʕu.ˈju:n/→ [ˈʕyu:n] ‘eyes’

(Harrama 1993:31)

According to Watson (2002), syncope in San'ani Arabic not only targets short vowels in order to decrease the number of monomoraic syllables and maximize bimoracity, but vowels at the beginning of phonological words are targeted by syncope in order to create bi-consonantal clusters in the onset position. Furthermore, in this dialect, unstressed short vowels at the end of the phonological word do not undergo syncope (Watson 2002), unlike unstressed short vowels in non-final monomoraic syllables, as in (3.58) below:

(3.58)

a. /fi.ˈhim.tii/ → [ˈfhim.ti:] ‘you (fm. sg.) understood’

b. /ka.ˈtabt/ → [ˈktabt] ‘I wrote’

c. /hi.ribt/→ [hribt] ‘I fled’

d. /ʤi.ˈlist/→ [ˈʤlist] ‘I stayed’

e. /ka.ˈbi:r/→ [ˈkbi:r] ‘big, old (ms. sg.)’

f. /ni.ˈχaz.zin/→ [ˈnχaz.zin] ‘we store’

As shown in the examples in (3.58), first syllables from the left are never stressed. As a result, short vowels in these syllables become the target of syncope, and initial bi-consonantal clusters are created.

On the other hand, Al-Mozainy (1981) claims that verbs in the form CaCaC that are suffixed with vowel-initial affixes undergo the processes of syncope and vowel raising. Syncope targets a low vowel /a/ in an antepenultimate light syllable which is followed by a light penultimate syllable; e.g., CaCaC-a→Ca.Ca.Ca.→CCa.Ca. Syncope targets a low vowel in the penultimate syllable because this syllable is followed by a light syllable with a low vowel /a/. Therefore, the aim of this process is to reduce the number of non-final CV syllables. The second process is vowel raising which targets a low vowel /a/ in the penultimate syllable since it is not flanked by gutturals or not preceded by sonorants [n, l, r, w] in open syllables. Consider the following examples:

(3.59)

a. /k**<u>a</u>**tab-at/ →syncope→ /kta.bat/→ vowel raising → [.kti.bat.]   ‘she wrote’

b. /k**<u>a</u>**.tab-u/→syncope→/kta.bu/→ vowel raising→ [kti.bu] ‘they wrote’

c. /s**<u>a</u>**.ħab-at/→syncope→/sħ<u>a</u>.bat/→vowel raising→≠→ [sħa.bat] ‘she pulled’

As shown in the examples in (3.59), a low vowel /a/ in the penultimate syllable which results from the association of the verb in the form CaCaC with a vowel-initial suffix is syncopated in order to reduce the number of non-final CV syllables. The raising process targets a low vowel /a/ in the penultimate syllable in (3.59-a, b) since this vowel is not flanked by gutturals or preceded by the sonorants [l, n, r, w]. Unlike (a) and (b), vowel raising is blocked in (c) because a low vowel /a/ in the penultimate syllable follows a guttural /ħ/.

Sakarna (2005) supports Al-Mozainy's (1981) claim when he adheres to the trisyllabic elision (TSE) introduced by Irished (1984:25) in order to justify having initial consonant clusters in modern Jordanian dialects. Irshied (1984:25) defines TSE as "a phonological rule that deletes a short low vowel in an open syllable if it is followed by a non-final short open syllable." This rule is implemented on the stems of Measure I verbs as well as nouns in the form CaCaC (Sakarna 1999). The form CaCaC becomes trisyllabic when it is associated with a vowel-initial suffix. As a result, the light antepenultimate and penultimate motivates 'trisyllabic elision'; i.e. the low vowel in the light antepenultimate syllable is targeted by syncope. His finding is shown in (3.60):

(3.60)

a) Underlying representation: /ba.gar+ak/→ /ba.ga.rak/

TSE: [bga.rak] 'your cows'

b) Underlying representation: /ʤa.raħ+ak/→ /ʤa.ra.ħak/

TSE: [ʤra.ħak] 'he cut you (ms. sg.)'

According to Rakhieh (2009), initial bi-consonantal clusters result from the deletion of low vowel /a/ in non-final open syllables in Ma'ani Arabic. He refers to Al-Mozainy (1981), Irshied (1984) and Sakarna (1999, 2005) who report that a low vowel /a/ in an open light syllable is systematically deleted in Bedouin Jordanian dialects when it is followed by a non-final open syllable, as in (3.61):

(3.61) Data from Sakarna (1999:47-48)

Input	Output	Gloss
a. bagara	bga.ra	'cow'
b. bagar-i	bga.ri	'my cows'
c. bagar-hin	bagar.hin	'their'

The low vowel /a/ is deleted in (a) since it is preceded by a non-final open syllable. This phenomenon is known as a tri-syllabic elision which is common among many Bedouin dialects, particularly NA and Bedouin Hijazi Arabic, as reported by Al-Mozainy (1982); i.e., CV.CV.CV→CCV.CV. The same low vowel is deleted in (b) due to the association with a vowel-intial suffix. However, syncope does not target a low vowel /a/ in the antepenultimate syllable in (c) because the penultimate syllable is not light. In other words, the verb form of (c) CaCaC is associated with a consonant-initial affix which results a heavy penultimate. Therefore, TSE does not target a low vowel in the antepenultimate syllable since the penultimate one is heavy, unlike in (a) and (b).

On the other hand, Al-Mohanna (1998) crucially states that, in UHA, an unstressed high short vowel /i/ in a light penultimate syllable which results from the association with a vowel-initial affix undergoes syncope. Consider the following examples:

(3.62)

I. a. /ʃa:.ʕir+ak/→ [ʃa:ʕ.rak] 'your (ms. sg.) male poet'

b. /tˤa:.lib+e:n/→ [tˤaal.been] 'two students'

c. /ʃa:tˤir+ah/→ [ʃaatˤ.rah] 'bright (fm. sg.)'

d. /ʤa:.hil+aat/→ [ʤaah.laat] 'ignorant (fm. pl.)'

II. a. /ki.bir+u/→ [kib.ru] 'they grew up'

b. /nidim+at/→ [nid.mat] 'she felt remorse'

c. /simiʕ+ak/→ [sim.ʕak] 'he heard you (ms. sg.)'

d. /ʕirif+uh/→ [ʕir.fuh] 'he recognised him'

The medial unstressed short vowel /i/ is deleted in words in (3.62 I-II).Vowels in initial syllables are not deleted; otherwise, words would have initial bi-consonantal clusters which are banned in UHA. In (3.62-I), the medial high short vowel /i/ is deleted due to a vowel-initial affix. As a result, non-final CVVC is created. In (3.62-II), an initial closed heavy syllable is created due to the deletion of medial high short vowel /i/.[31] Al-Mohanna (1998) presents a rule which describes this behaviour in (3.63) below:

(3.63) A high vowel [i] → Ø / VC_____CV

(Al-Mohanna 1998:172)

[31] Rakhieh (2009) reports the same behaviour in Ma'ani Arabic in which the suffixation of a vowel-initial affix results a non-final derived CVVC:
a. /sˤaa.ħib-u/→ / sˤaa.ħ**i̱**.bu/→ [sˤaaħ.bu] 'his friend'
b. /faa.him-i/→ /faa.h**i̱**.mi/→ [faah.mi] 'she understood'

This behaviour is accounted for using OT; the candidates of the input /ki.bir+u/are evaluated by the following constraints:

(3.64)

a) Max-Low V (Davis 1997:5)

A low vowel in the input must have a correspondent in the output.

b) Max-Hi V (Davis 1997:5)

A high vowel in the input must have a correspondent in the output.

c) SYL-MIN (Wd-Int) (Al-Mohanna 1998:153)

This constraint is violated by word internal light syllables.

After illustrating OT constraints in (3.64) above, the candidates of the input /ki.bir+u/ will be evaluated in the tableau below:

(3.65)

/ki.bir+u/	*COMPLEX	ALIGN-RIGHT	Max-Low V	SYL-MIN(Wd-Int)	Max-Hi V	DEP-IO	SYL-MIN
☞ a. kib.ru					*		*
b. ki.bi.ru				*!			***
c. ki.bir		*!			*		*
d. kbi.ru	*!				*		**

The desired output (a) becomes the optimal candidate of the input /ki.bir+u/, because it has no violation of highly-ranked constraints, whereas the output (b) has been eliminated from being optimal due to its violation of SYL-MIN (Wd-Int), even though it is the most faithful to the input. Other candidates (c) and (d) could not become optimal outputs since they violate the most highly-ranked constraints *COMPLEX and ALIGN-RIGHT.

Likewise, according to Watson (2002), in Cairene Arabic, syncope results from the association of a phonological word with a vowel-initial affix, as in (3.66):

(3.66)

a. /wi.ħ**i**ʃ+a/→ [wiħ.ʃa] 'bad (fm.)'

b. /xul**u**sˤ+it/→ [xul.sˤit] 'she finished'

c. /ma:s**i**k+a/→ [maska] 'taking hold (fm.)'

d. /ra:g**i**l+e:n/→ [rag.leen] 'two men'

e. /saf**i**r+u/→ [saf.ru] 'they travelled'

Rose (2000) adheres to Farwaneh (1995:102) in order to analyse syncope in Iraqi Arabic that results from an unstressed short vowel in a light penultimate syllable. She notes that a short vowel /a/ in an unstressed light syllable in the word /ki.ta.bat/ undergoes syncope since the final syllable is suffixed with a vowel-initial affix /-at/; i.e., /ki.tab-at/→ /ki.t**a**.bat/→ [kit.bat] 'she wrote'. She accounts for this behaviour using OT, presenting some constraints that will be used to evaluate the candidates of the input /ki.tab-at/ 'I wrote'.

(3.67)

a. MAX-IO (McCarthy 1995)

Every segment of the input has a correspondent in the output (no deletion)

b. *UNSTRESSED V (*V̌) (Rose 2000)

*Unstressed short vowel in two-sided open syllable

(3.68)

/ki.tab-at/	*V̌	MAX-IO
☞ a. ˈkit.bat		*
b.ˈ ki.ta.bat	*!	

However, the short vowel in the light antepenultimate syllable is not deleted since the form CaCaC is associated with a consonant-initial suffix. This statement is supported by

Al-Mohanna (1994:80) who notes that syncope in Taifi is not triggered by consonant-initial affixes.[32] He presents some examples that demonstrate how syncope is blocked below:

(3.69)

a. /ri.kib-na/→ [.ri.kib.na.] 'We rode'

b. /ni.dim-tu/→ [.ni.dim.tu.] 'You (pl.) felt sorry'

This behaviour is not analysed by Al-Mohanna (1994) using OT. By using the following constraint, the output [ri.kab.na], for example, can be chosen as optimal:

(3.70) SYLL-ALIGN (L) (Mester and Padgett 1994)

Every syllable must be aligned with the left edge of some prosodic word. The distance between the syllable and the left edge is computed by the number of moras.

	Syll-ALIGN (L)		
/ri.kib-na/	S_1	S_2	S_3
☞a. $ri_{\mu}.ki_{\mu}b_{\mu}.na_{\mu}$	Ø	μ	μμμ
b. $rki_{\mu}b_{\mu}.na_{\mu}$	Ø	μμ!	Ø

In UHA, Al-Mohanna (1998) states that the blocking of the deletion of an unstressed short vowel in a light penultimate syllable applies, even if a phonological word is associated with a vowel-initial suffix due to avoidance of non-final CVCC, as shown in the examples below:

(3.71)

a. /ti.tar.dʒim-uh/ → [ti.tar.dʒ**i̱**.muh] / *[ti.tardʒ.muh] 'she translates it *ms.*'

[32] Abu-Mansour (1987) reports how syncope is blocked when a phonological word is suffixed with a consonant-initial affix in Meccan Arabic; e.g., /rikib-na/→ [ri.kib.na] /* [rkib.na] 'we rode', /ki.bir-na/→ [ki.bir.na] /*[kbir.na] 'we grew up'. The reason for blocking syncope is to avoid an initial biconsonantal cluster in this dialect in particular. Furthermore, there is no unstressed short vowel in a light penultimate created when associating with a consonant-initial affix, compared to a vowel-initial suffix. In Bedouin Hijazi Arabic, according to Al-Mozainy (1981), the same behaviour is found for the same reason. Moreover, an unstressed short vowel in a one-sided open syllable is targeted by syncope when the following syllable is either CVVC or CVCC, or if this syllable is in the antepenultimate position preceded by a heavy penultimate syllable, beyond the association of affixes, according to the stress parameters in Bedoiun Hijazi Arabic demonstrated by Al-Mozainy (1981).

b. /ji.tar.dʒim-uh/ → [ji.tar.dʒ**i̲**.muh] / *[yi.tardʒ.muh] 'he translates it *ms.*'

c. /ti.tar.dʒim-i/ → [ti.tar.dʒ**i̲**.mi] / *[ti.tardʒ.mi] 'you *fm. sg.* translate it'

d. /jiħ.rig-u/ → [jiħ.r**i̲**.gu] / *[jiħr.gu] 'they burn'

e. /ni.kal.lim-ak/ → [ni.kal.l**i̲**.mak]/ *[ni.kall.mak] 'we call you *ms. sg.*'

f. /ti.kal.lim-ak/ → [ti.kal.l**i̲**.mak]/ *[ti.kall.mak] 'she calls you *ms. sg.*'

g. /tis.tag.bil-ik/ → [tis.tag.b**i̲**.lik]/ *[tis.tagb.lik] 'she meets you *fm. sg.*'

h. /ti-stagbil-ak/ → [tis.tag.b**i̲**.lak]/ *[tis.tagb.lak] 'she meets you *ms. sg.*'

i. /jis.tag.bil-ak/ → [yis.tag.b**i̲**.lak]/ *[yis.tagb.lak] 'he meets you *ms. sg.*'

j. /mudʒ.rim-ah/ → [mudʒ.r**i̲**.mah] / *[mudʒr.mah] 'criminal *fm. sg.*'

The examples above show that the deletion of an unstressed short vowel in a two-sided open syllable results in a non-final CVCC, which is not tolerated by UHA. Therefore, there is no option but to accept a two-sided open syllable with its unstressed nucleus. This behaviour is also noted by Al-Mozainy (1981) who presents some examples from Bedouin Hijazi Arabic that show how syncope is blocked to avoid non-final CVCC; e.g., /jiʃrik-u:n/→[jiʃ.ri.ku:n] /*[jiʃr.ku:n] 'they become non-believers', and /jisrig-uun/→ [jis.ri.gu:n]/*[jisr.gu:n] 'they steal'.

Al-Mohanna (1998) accounts for such behaviour using OT. He evaluates the candidate of the input /mudʒ.rim-ah/. Consider the following tableau:

(3.72)

/mudʒrim+ah/	*COMPLEX	MAX-C	No[i]	MAX-μ(B/O)	RIME-EXHAUS	MAX-μ
a. mudʒr.mah	*!			*	*	*
☞b. mudʒ.ri.mah			*			
c. mudʒ.mah		*!		*		*

The tableau above distinguishes the desired output (b) as an optimal candidate because it avoids the violation of highly-ranked constraints. Furthermore, it is the most faithful to the input, compared to the other outputs. Output (a) avoids the violation of No[i] by the deletion of medial short vowel /i/, but it does not avoid the violation of *COMPLEX. Therefore, it has been eliminated from being optimal. Output (c) satisfies *COMPLEX through the deletion of /r/, as a semisyllable, but it fails to be selected as optimal due to the violation of MAX-C.

Rakhieh (2009) observes that some unstressed vowels in non-final light syllables in Ma'ani Arabic are immune to syncope, even though these vowels are in environments where they become an easy target for syncope, as in (3.73):

(3.73)

a. /mu.'di:r/→ [mu.'di:r] /*[mdi:r] 'manager'

b. /ma.lik-i/→ [ma.li.ki] / *[mal.ki] 'my king'[33]

c. /ru.sul-u/→ [ru.su.lu] / *[rus.lu] 'his messengers'

He states that the reason for the immunity to syncope is that the words above are governed by the phonology of standard Arabic rather than the phonology of Ma'ani Arabic since they are loanwords. In other words, the words above are borrowed from Modern Standard Arabic and their unstressed short vowels in non-final open syllables do not undergo syncope, even though these vowels are in appropriate environments to be syncopated.

To conclude, syncope is demonstrated in this section as a process that targets an unstressed high short vowel in a non-final open light syllable which is preceded by syllables of the forms CVVC, CVCC, and CVG. Moreover, Trisyllabic Elision (TSE) syncopates a short vowel in a light syllable in the penultimate position when it is followed by a light penultimate syllable. An unstressed short vowel in the light penultimate syllable that results from the association of form CV.CVC with a vowel-initial affix always triggers syncope unless it results in non-final CVCC or if it is found in loanwords from Standard Arabic. Furthermore, syncope is blocked when a CaCaC

[33] Al-Mohanna (1998: 151) reports an exceptional case in which an unstressed short vowel in a two-sided open syllable does not undergo syncope in UHA; e.g., /ma.lik-i/→ [ma.li.ki] /*[mal.ki] 'my king', /ma.lik-ah/→ [ma.li.kah]/*[mal.kah] 'queen'.

form is suffixed with a consonant-initial affix, unlike in the case of vowel-initial suffix. An unstressed short vowel in a light penultimate syllable in loanwords from Standard Arabic also does not undergo syncope. The next section is specific to metathesis as one of the major syllable structure processes in Arabic that creates initial consonant clusters.

3.5 Previous Research on CV Metathesis

CV metathesis in Arabic has been investigated by scholars including Abboud (1979), Ingham (1994), Zawaydeh (1999), Blevins & Garrett (2004), and Al-Solami (2013), even though they do not use OT to analyse the process; Some of these studies are discriptive like Abboud's (1979), and Ingham's (1994) works. Zawaydeh (1999) provides an acoustic analysis of metathesis that is triggered by non-emphatic gutturals in the coda position of non-final syllables as Al-Solami (2013). Likewise, CV metathesis in NA is phonetically analysed by Blevins and Garrett (2009). This process undergoes the analysis of OT in sections 4.5 and 5.2.

Initial bi-consonantal clusters are created by CV metathesis. In NA, Abboud (1979) and Ingham (1994) Blevins & Garrett (2004), point out a type of metathesis—namely the Guttural Resyllabification which is ,in fact, based on switching the places of a vowel and a guttural (uvular, pharyngeal, and laryngeal) which results in initial bi-consonantal clusters; e.g., /taχdim/→ [**tχ**adim] 'you (ms. sg.)'.

(3.74) Guttural Resyllabification (CV metathesis):

a. /gahwa/→ [ghawa] 'coffee'

b. /naʕʤat/ → [nʕaʤat] 'ewe'

Zawaydeh (1999) accounts for gutturals in some modern Arabic dialects and Biblical Hebrew. She states that final syllable gutturals cannot be tolerated in some Arabic dialects. They are re-syllabified as onsets after vowel insertion in Negev Bedouin Arabic; e.g., /CVG.CV/ (where G stands for a guttural) → [CV.GV.CV]. In Bedouin Hijazi Arabic (Al-Mozainy 1981), the underlying form /CVG.CV/ changes to a surface form [CGV.CV] by metathesis (Guttural Resyllabification).

Al-Solami (2013) examines metathesis in Bedouin Hijazi Arabic and notes that the reason for this process is a guttural consonant that stands in the coda position in a non-final syllable. As a result, metathesis is permitted in this dialect in order to avoid this type of consonants in the coda position of a non-final syllable. This is demonstrated by the examples below:

(3.75) Metathesis in Bedouin Hijazi Arabic

a. /naʕ.ʤah/→ [nʕa.ʤah] 'goat'

b. /laħ.mah/→ [lħa.mah] 'a piece of meat'

c. /maʁ.rib/→ [mʁa.rib] 'sunset'

d. /raχ.mah/→ [rχa.mah] 'coward'

e. /gah.wa/→ [gah.wa] 'coffee'

f. /saʔ.lat/→ [sʔa.lat] 'she asked'

The examples above show that the guttural consonants including /χ/, /ʁ/, /ħ/, /ʕ/, /ʔ/, and /h/ are not allowed in the coda position of a non-final syllable. Therefore, it is metathesized with the preceding low vowel /a/. However, there are some types of gutturals known as 'emphatics' (Zawaydeh 1999) which do not behave like /χ/, /ʁ/, /ħ/, /ʕ/, and /h/; i.e. the emphatics are /tˤ/, /dˤ/, /sˤ/, and /ðˤ/. In other words, CV metathesis is not triggered by emphatics which are in the coda position of non-final syllables, according to Al-Solami (2013). Consider the following examples:

(3.76) Non-metathesis in Bedouin Hijazi Arabic

a. [ʔitˤ.laʕ] 'come out'
b. [ʔiðˤ.rub] 'I hit'
c. [masˤ.laχ] 'slaughter house'

To conclude, CV metathesis is discussed in this section as a process that results from swapping a guttural consonant with a preceding low vowel in the coda position in a non-final syllable. This process is shown to be the most common behaviour found in Bedouin Arabic dialects in general and in Gulf dialects. However, this process is not applied to the entire set of guttural consonants. Some guttural consonants in the coda position in non-final syllables do not trigger CV metathesis as demonstrated by Zawaydeh's (1999) and Al-Solami's (2013) observations with respect to emphatics; e.g. /ʔitˤ.laʕ/→ [ʔitˤ.laʕ]/ * [ʔtˤi.laʕ] 'come out'.

3.6 Summary

This chapter provides an overview of syllable structure processes in modern Arabic dialects, including epenthesis, vowel shortening, syncope, and CV metathesis. These processes are motivated by different factors. For instance, vowel epenthesis results from the violation of the SSP, complexity found in the onset position, and non-final superheavy syllables. The violation of the SSP in the coda position is demonstrated in this chapter as a factor that attracts internal epenthesis rather than the violation of the SSP in the onset position in some modern Arabic dialects. However, in MHA, this epenthesis is blocked in order to avoid lexical homonymy (Jarrah 1993). This type of epenthesis is also provoked by non-final superheavy syllables of the forms CVVC and CVCC. But this does not apply to all modern Arabic dialects, while some dialects tolerate these syllables through mora sharing in order to avoid a semisyllable remaining unaffiliated to the syllable node. Other dialects affiliate a semisyllable to the syllable node by mora sharing if the preceding syllable has a long vowel. On the other hand, initial epenthesis (prosthesis) is utilized to avoid the complexity in the onset position which results from initial consonant clusters in some VII /nfaʕal/, VIII /ftaʕal/, and X /stafʕal/. Likewise, initial consonant clusters in some imperative forms in Arabic are broken up by prosthesis rather than internal epenthesis. Initial geminates motivate prosthesis as do consonant clusters in some triliteral verbs and imperative forms.

Long vowel shortening aims to reduce a long vowel in a hollow verb which is associated with subject verb agreement suffix; e.g., /g**a:**l+t/ → [gilt] or [gult] ‘I said’. The process is also motivated by the avoidance of an unstressed heavy syllable that is created in the final position after the deletion of a glottal stop; e.g. /ħamraaʔ/→ /ħamraa/→ /ħamra/ ‘red (fm.)’. The stress clash is considered to be another motivating factor for long vowel shortening; e.g., /ba:b-i:n/→long vowel shortening → [ba.ˈbi:n]/*[ˈba:.ˈbi:n].

Syncope is explained in this chapter as a process that targets an unstressed high short vowel in a non-final light syllable which is followed by CVVC, CVCC, or CVG syllables. This phenomenon is found in some modern Arabic dialects that tolerate initial consonant clusters, especially Bedouin dialects. A vowel in a light antepenultimate syllable that is followed by a light penultimate also undergoes syncope in order to reduce the number of CV syllables; this behaviour is known as Trisyllabic Elision (TSE). Furthermore, a light penultimate syllable that results from the association of the verb in the form Ca.CaC with a vowel-initial suffix is targeted by TSE. On the other hand, an unstressed short vowel in a light penultimate syllable attracts syncope if it does not result in a non-final CVCC. A verb in the form Ca.CaC that is associated with a consonant-initial suffix does not motivate syncope. Syncope is also blocked when an unstressed short vowel in a light penultimate syllable is in loanwords which are governed by Standard Arabic.

CV metathesis is motivated by a guttural consonant in the coda position and the preceding low vowel /a/ which results in an initial consonant cluster. However, the entire set of gutturals does not undergo CV metathesis. Emphatics behave like other consonants which are not [+Pharyngeal]; e.g. /ʔitˤ.laʕ/→ [ʔitˤ.laʕ] / * [ʔtˤi.laʕ] ‘come out’.

In the next two chapters, five main questions of the thesis will be addressed; firstly, what insights about NA syllable structure and related processes can be gained through OT? Secondly, what is the source of initial bi-consonantal clusters in NA? Thirdly, how are non-final superheavy syllables of the forms CVVC and CVCC avoided in NA? Fourth, to what extent are sonority violations tolerated in some final consonant clusters in NA? Finally, what are the motivating factors for vowel shortening in NA?

Chapter 4. The Syllable Structure of Najdi Arabic

4.1 Introduction

The goal of the current chapter is to assess various other characteristics of the phonology of NA. This chapter discusses the syllable structure of NA through OT analysis. This chapter will also address two questions. This first question is related to the source of bi-consonantal clusters in NA while the second question is specific to the insights into NA syllables and processes that can be gained through OT analyses. Section 4.2 addresses how the underlying form is determined in NA. Section 4.3 gives an overview of syllable types in NA and their distribution. Section 4.4 illustrates the capacity of OT to analyse syllable structure. In section 4.5, onsets in NA will be explained and accounted for using OT. Likewise, section 4.6 demonstrates codas in NA in light of OT; sections 4.5 and 4.6 address the question related to the sources of consonant clusters in NA. Stress and syllable weight in NA are discussed in section 4.7 in order to differentiate between light and heavy syllables. Section 4.8 deals with superheavy syllables in NA. In section 4.9, the unfied set of constraints will be proposed in order to analyse the NA syllable structure; this section will specifically address the question related the insights about NA syllable structure that can be gained through OT. The final section (4.10) will provide the summary and conclusion of this chapter.

4.2 How to determine the input in this dialect?

The term *diglossia* in the mid-20th century has been used to describe the socio-linguistics situation in most Arabic-speaking countries (Jasim & Sharhan 2013). There are two distinct language systems used in each Arabic-speaking region (cf. Ferguson 1959). Standard Arabic (henceforth SA) is the prestigue language system which is mainly used for official communication in governments, news reporting, and education and it is essentially written (Haddad 2006, Elramli 2012, Jasim & Sharhan 2013). Also, this language is used for reading and listening to television and radio (cf. Maamouri 1998). The second language system is the spoken Arabic varieties, i.e. Arabic vernaculars; these are typically of lower prestigue. The spoken Arabic varieties which are called *Ammiyyah* are used as means of communication. In other words, Arabic varieties are used orally in everyday life activities in streets, homes, markets, etc (Jasim

& Sharhan 2013). These varieities are different from SA and from each other in pronunciation, vocabulary, and grammar. The present study sheds light on one of the Arabic vernaculars spoken in Najd province in Saudi Arabic known as Najdi Arabic (NA). According to Haddad (2006), Arabic native speakers learn their dialects in their early ages then SA in formal education. Similarly, children native speakers of NA learn their dialect first before SA in schools. Kager (1999:414) notes that within the framework of OT it is assumed that the input simply equals output unless there is reason to deviate due to *Lexicon Optimization*. The notion of *Lexicon Optimization* states that the chosen underlying form is the one that maps onto the surface form with the least significant violation marks (Yip 1996). Accordingly, inputs in the present study are taken from NA. Some NA inputs map onto NA outputs; e.g., /χu.ˈʃu:m/ 'noses', /ʕi.ˈna:d/ 'stubbornness', /zu.ˈlu:f/ 'sideburns', /mu.ˈʃu:χ/ 'scratches', /nu.ˈʕu:l/ 'shoes', /ˈzaʕ.lat/ 'she is upset', /zi.ˈba:.lah/ 'trash', /ku.ˈra: ʕ/ 'leg', /ˈʤa:.b$_{\mu}$-hum/ 'he brought them', /tu.ˈʃu:f/ 'you (m) see/she sees', /fi.ˈlu:s/ 'money'.

(4.1)

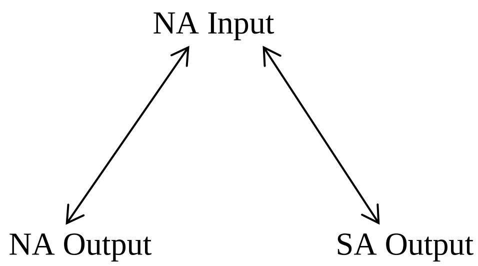
NA Input	NA Output	Gloss
a. /ku.ˈru:t/	[kru:t]	'cards'
b. /gu.ˈbu:r/	[ˈgbu:r]	'graves'
c. /fu.ˈnu:n/	[ˈfnu:n]	'arts'
d. /ħi.ˈza:m/	[ˈħza:m]	'belt'
e. /nu.ˈʕu:l/	[ˈnʕu:l]	'shoes'
f. /χu.ˈʃu:m/	[ˈχʃu:m]	'noses'
g. /tu.ˈra:b/	[ˈtra:b]	'sand'
h. /ˈzaʕ.lat/	[ˈzʕa.lat]	'she is upset'

The phonological processes including CV metathesis, vowel epenthesis, vowel shortening, and syncope occur in the output level; e.g., /ku.ˈru:t/→ [ˈkru:t] 'cards'.[34] However, a few NA inputs map onto SA outputs since these inputs, for example, are taken from SA (SA loanwords); e.g., /mu.ˈdi:r/ 'manager', /ˈma.li.kah/ 'queen', /ħa.ˈwa:.mil/ 'pregnant', and /χu.ˈsˤu:m/ 'opponents. Unstressed short vowels in these inputs do not undergo syncope in the output level in NA because these inputs are governed by the phonology of SA in the output level even though these vowels are in

[34] These phonological processes are demonstrated in this chapter and chapter 5.

appropriate environment for syncope in the Najdi native lexicon. This behaviour is discussed in detail in section 5.5. The tree diagram below shows the assumed input and output in NA:

(4.2)



In the next section, I will demonstrate the syllable types in NA and their distribution.

4.3 Syllable Types and Distribution in NA

According to Abboud (1979), Ingham (1994) and Alezetes (2007), the syllable types in NA are shown below (a dot indicates a syllable boundary):

Table 4.1 The syllable types in NA

Syllable structure	Example	Translation
a. CV	[**ʔa**.kal]	‘he ate’
b. CVC	[gi.**tal**]	‘he killed’
c. CVV	[**saa**.ʕah]	‘an hour’
d. CVVC	[raaħ]	‘he was gone’
e. CVCC	[bard]	‘cold’
f. CCV	[**tχa**.dim]	‘you (ms.sg.) serve’
g. CCVC	[**tkal**.lim]	‘‘you (m) are talking to’
h. CCVV	[**zba:**.lah]	‘trash’
i. CCVVC	[gbu:r]	‘graves’
j. CCVCC	[smint]	‘cement’

Syllable types in NA in table (4.1) can be divided into three groups: light, heavy, and superheavy syllables. The light syllables are CV, CCV while CVC, CVV, CCVC, and CCVV are heavy. The superheavy syllables are CVVC, CVCC, CCVVC, and CCVCC.

According to the syllable types shown in table 4.5, there are two observations to make. Firstly, single onsets are required while codas are optional. All syllables above have either single or complex onsets; however, syllables such as CV, CVV, CCVV and CCV do not have codas. This shows that codas are not obligatory, while at least single onsets are. The second observation is related to the way that these syllable types are listed. Why does the table above show CV as the first syllable type and CCVCC as the last? The syllables above are listed depending on their weight and position. For instance, CV is the only syllable which retains its weight regardless of its position. To put it another way, this syllable is freely found in initial, medial, and final position as a light syllable. CVC is also found in the initial, medial, and final position. Unlike the CV syllable, as discussed in subsection 2.5.1, this syllable counts as light in the final position if the antepenultimate syllable or penultimate syllable is stressed, as in/'mak.ti.ba<h>/ ‘library’. In other words, CVC counts as a light syllable in the final position if the antepenultimate is stressed. The final consonant of CVC in the final position becomes extrametrical (non-moraic); i.e., ['CVC.CV.CV<C>]. CVV is found initially and medially as a heavy syllable but it is not found in the final position (Abboud 1979). In other words, there is a restriction on the position of this syllable since it sufaces as a heavy syllable only in the initial and medial positions. CVVC appears in initial and medial positions as a heavy syllable via mora sharing in order to avoid a semisyllable, as discussed by Watson (2007; see subsection 2.5.2). Mora sharing is not used to affiliate the last consonant in final CVVC to the syllable since this consonant is assigned as a degenerate syllable (an extrasyllabic consonant; see subsection 2.5.1).Unlike CVVC, there is a restriction on the position of CVCC since it is found in the initial position where the last consonant is assigned as extrasyllabic; i.e./CVC.CVCC/→ [CVC.CVC.C]. Syllables with complex onsets are found in the initial position only regardless of their weight. This idea is addressed by Abu-Salim (1982) who notes that complex onsets are restricted to the initial position because they are created in the non-final position by the deletion of an unstressed short vowel and the unstressed short vowel in the final position never undergoes the deletion.[35] Therefore, consonant clusters are not found in the final syllable. The syllable types CCV, CCVC, CCVV, CCVVC, and CCVCC are found in the initial position only due to the

[35] Guttural Resyllabification (CV-metathesis) never targets a final syllable.

restriction on their position. CCVCC is only found in monosyllabic words, unlike the other syllables.[36] Consider the distribution of syllable types in the following table:

Table 4.2 The distribution of syllable types in disyllabic words in NA

Syllable type	Initial	Medial	Final
CV	[**qi**.tal] 'he killed'	[yis.**ti**.ʃiir] 'he consults'	[zir.**na**] 'we visited'
CVC	[**ʃar**.ban] 'he was drunk'	[ʃaa.**fat**.hum] 'she saw them'	[ˈki.tab] 'he wrote'
CVV	[**ha:**.ʤim] 'he attacked'	[mis.**ta:**.ʤir] 'a tenant'	-
CVVC	[**ʃa:f**.hum] 'he saw them'	[mi.**ga:s**.hum] 'their size'	[yiχ.**ta:r**] 'he selects'
CVCC	-	-	[wiʃ.**gilt**][37] 'what you said'
CCV	[**kti**.bat] 'she wrote'	-	-
CCVC	[**tkal**.lim]'you (m) are talking to'	-	-
CCVV	[**zba:**.lah]'trash'	-	-
CCVVC	[kla:b.na] 'our dogs'	-	-
CCVCC	-	-	-

In conclusion, the syllable types and their distribution are described in this section and can be summarised as follows. The syllables are divided into three groups: light syllables are CV and CCV; the syllable forms CVC, CVV, CCVC, and CCVV are heavy. Superheavy syllables are CVVC, CVCC, CCVVC, and CCVCC. This dialect does not permit onsetless syllables as do other dialects: the onset is obligatory. Furthermore, this dialect is one of the modern Arabic dialects that allows complex onsets. Codas in this dialect are optional since there are some syllable types that lack

[36] This syllable is found in an English loanword *cement* : i.e. /sment/.

[37] The peripheral consonant /t/ in the word [wiʃ.gilt] is extrasyllablic as well as the peripheral consonant /r/ in the word [yiχ.taar] . As a result, the last syllable is heavy rather than superheavy heavy (see section 2.5.1).Watson (2002) addresses the difference between extasyllabicity and extrametricality and states that an extrametrical consonant is found in the final unstressed syllable of the form CVC when the penultimate syllable, which is stressed of course, is CV; e.g., /ˈki.tab/→ [ˈki.ta<b>]. An extrasyllabic consonant is found peripherally in the final syllables of the form CVCC in San'ani Arabic (Watson 2002).

codas like CV, CCV, CCV, and CCVV. The onset and codas in NA are demonstrated through OT in sections 4.4 and 4.5. The CVC syllable in NA is considered to be heavy in the non-final position and light in the final position due to the assignment of the last consonant as extrametrical. The final superheavy syllables of the form CVVC and CVCC are heavy because the last consonant is assigned as extrasyllabic. The weight of syllables and superheavy syllables are analysed in OT in sections 4.6 and 4.7. In terms of the distribution of syllable structures in NA, CV occurs initially, medially, and finally, as a light syllable, whereas CCVCC is only found in monosyllabic words; hence, the CV syllable is found initially if the ultimate syllable is of the form CVC; e.g., [**gi**.tal] 'he killed'. Also, this syllable is in the penultimate position to avoid non-final superheavy syllables of the form CVCC; e.g., [jis.**ti**.ʃiir] /* [jis.t_{μ}.ʃiir] 'he consults'. This behaviour is demonstrated in section 5.5 in Chapter 5. In section 4.4, I show how OT can account for the syllable structure in general.

4.4 Syllable Structure from an OT perspective

The inventories of syllable structures in languages can be attributed to the interaction between markedness and faithfulness constraints in OT. According to Prince and Smolensky (2004), the basic syllable shapes can be accounted for by the following markedness constraints:

(4.3) Markedness constraints:

a. ONS

Syllables must have onsets.

b. *CODA (NO-CODA)

Syllables must not have codas.

These constraints require that a nucleus is obligatory in each syllable, that the ONS constraint is violated by syllables that lack onsets, and that syllables that have codas violate the *CODA (NO-CODA) constraint. The only syllable type that satisfies all of these constraints at the same time is CV, which is cross-linguistically the least marked syllable type. This syllable has both a nucleus and an onset but lacks a coda.

The desired syllable types result from the interaction between markedness and faithfulness constraints, assuming that constraints may be ranked in terms of importance.

The main faithfulness constraints are MAX-IO and DEP-IO which is against deletion and epenthesis relative to the input, respectively. These constraints are illustrated below:

(4.4) Faithfulness constraints

a. MAX-IO

An input segment has a correspondent segment in the output (No deletion).

b. DEP-IO

An input segment has a correspondent segment in the output (No epenthesis).

There are two markedness constraints which must be violated in order to account for complex margins; i.e. *COMPLEX$_{ONS}$ and *COMPLEX$_{CODA}$. To put it another way, a language which permits complex onsets and/or complex codas must allow one or both of these constraints to be violated:

a. *COMPLEX$_{ONS}$

A syllable must not have more than one onset segment.

b. *COMPLEX$_{CODA}$

A syllable must not have more than one coda segment.

The primary syllable inventories found in languages are accounted for by the different rankings of constraints in (4.3), (4.4), and (4.5). For instance, if onsets are obligatory while complex onsets are banned and complex codas are optionally permitted in a language X, then the ranking (4.6) below is required:

(4.5)

ONS>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

/CCVCC/	ONS	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞ a. /C**V**.CVCC/				*	*	*
b. /CCVCC/			*!		*	*
c. /CVC/		*!*				*

The tableau above shows that determining output (a) as an optimal candidate results from ranking *COMPLEX$_{ONS}$ and MAX-IO higher than DEP-IO and *COMPLEX$_{CODA}$. This ranking consequently eliminates both outputs (b) and (c) from being optimal. Otherwise, output (c) would become the optimal candidate if MAX-IO outranked DEP-IO. In NA, the candidates of the input /CVCC/ *bint* 'a girl' are evaluated in the next tableau:

(4.6) ONS>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

/CVCC/	ONS	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞ a. CVCC					*	**
b. CV.C**V**C				*!	*	*
c. CVC		*!				*

Candidate (a) is identified as optimal since it avoids the violation of the faithfulness constraints MAX-IO and DEP-IO. These constraints are violated by candidates (b) and (c). Candidate (b) allows vowel insertion to avoid the violation of the *COMPLEX$_{CODA}$ constraint but it fails to satisfy the DEP-IO constraint. Candidate (c) allows the deletion of the final segment to avoid the violation of the *COMPLEX$_{coda}$ constraint, but it does not avoid violating the MAX-IO constraint.

To conclude, the constraints in (4.3), (4.4), and (4.5) are universal, but the way these constraints are ranked is different, depending on the language under analysis. For instance, the set of constraints in (4.6) act on the candidates of the input /CVCC/ in NA in order to assign the output [CVCC] as optimal. In the next section, OT will be applied to the onset in NA.

4.5 The Onset in NA

In section 4.2, NA was shown to be a dialect that requires an onset; onsets are obligatory. The universal constraint ONS, discussed in section 4.3, and again in (5.3), will be highly-ranked in the grammar of NA because onsetless syllables are not allowed in this dialect.

(4.7) ONS (Prince and Smolensky 2004)

Syllables must have onsets.

NA also permits complex onsets which result from two phonological processes. The first is the deletion of an unstressed high short vowel in open syllables. Consider the following examples:

(4.8) **<u>Word-initial clusters in NA</u>**

a. /ði.ra:ʕ/→ [ðra:ʕ] 'an arm'
b. /si.la:ħ/→[sla:ħ] ' a weapon'
c. /zu.lu:f/→ [zlu:f] 'sideburns'
d. /fu.lu:s/→ [flu:s] 'money'
e. /ħi.ba:l/→ [ħba:l] 'ropes'
f. /ʕi.na:d/→ [ʕna:d] 'stubbornness'
g. /hu.nu:d/→ [hnu:d] 'Indians'
h. /hu.mu:m/→[hmu:m] 'concerns (n)'
i. /gu.ru:d/→ [gru:d] 'monkeys'
j. /ki.la:b/→[kla:b] 'dogs'
k. /ki.ta:b/→ [kta:b] 'a book'
l. /gu.ru:ʃ/→ [gru:ʃ] 'coins'
m. /ku.fu:f/→ [kfu:f] 'palms'
n. /ru.fu:f/→[rfu:f] 'shelves'
o. /tu.ra:b/→ [tra:b]'sand'

Word-initial clusters in the words above result from the syncope of an unstressed high short vowel in an open light syllable. Most consonant clusters above conform to the SSP (Sonority Sequencing Principle), except those in (4.8-m, n). A word-initial cluster in /kfu:f/ constitutes Plateau Sonority because both /k/ and /f/ are equally low in sonority. Reverse Sonority is found in the word-initial cluster in /rfu:f/ where the first member of this cluster /r/ is more sonorous than /f/. The constraints below along with the ONS constraint are used to evaluate the candidates of the input /ħi.ba:l/ 'ropes':

(4.9) a. MAX-IO (McCarthy & Prince 1995)

An input segment has a correspondent segment in the output (No deletion).

b. DEP-IO (McCarthy & Prince 1995)

An input segment has a correspondent segment in the output (No Epenthesis).

c. *COMPLEX$_{ONS}$ (Prince and Smolensky 1993)

A syllable must not have more than one onset segment.

d. *i]$_σ$ (Kenstowicz 1996)

High short unstressed vowels in open syllables are not allowed.

e. Sonority Sequencing Principle (SSP) (Roca 1994)

The sonority profile of the syllable must slope outwards from the peak.

In the next tableau, the constraints above with the ONS constraint will be used to evaluate the candidates of the input /ħi.'ba:l/ ‘ropes’.

(4.10) ONS>> *i]$_σ$>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO

/ħi.ba:l/	ONS	*i]$_σ$	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
a. ħi.'ba:l		*!				
☞b. ħba:l				*	*	
c. iħ.'ba:l	*!			*		*

In the tableau (4.10), candidate (c) forfeits optimality since it violates ONS as the most highly-ranked constraint. This violation results from the lack of onset. Candidate (a) is eliminated from being optimal due to the violation of the *i]$_σ$ constraint. Consequently, candidate (b) becomes optimal. The outputs of /ru.fu:f/ ‘shelves’ are accounted for using OT. Consider the following tableau.

(4.11) ONS>>*i]$_σ$>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO

/ru.fu:f/	ONS	*i]$_σ$	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
a. ru.'fu:f		*!				
☞b. rfu:f			*	*	*	
c. ir.'fu:f	*!			*		*

The candidate (b) becomes optimal because it avoids the violation of the constraints ONS and *i]$_\sigma$. The candidate (c) avoids the violation of the *COMPLEX$_{ONS}$ constraint by initial epenthesis, but it fails to satisfy the ONS constraint. The candidate (a) cannot be optimal due to the violation of the *i]$_\sigma$ constraint.

A complex onset in NA also results from the deletion of the vowel in the light antepenultimate syllable that is followed by a light penultimate syllable. Sakarna (1999, 2005) and Rakhieh (2009) refer to this phenomenon as 'Trisyllabic elision' (see 3.4). Consider the following examples:

(4.12) **<u>Initial consonant clusters in NA (trisyllabic elision)</u>**

a. /ˈga.ra.ʕah/	[ˈgra.ʕah]	'melon'
b. /ˈba.ga.ra/	[bga.ra]	'cow'
c. /ˈʕa.ʃa.ra/	[ʕʃa.ra]	'ten'

The word-initial clusters in (4.12) result from the deletion of a vowel in the light antepenultimate syllable that is followed by a light penultimate syllable in order to reduce the number of light syllables. The initial cluster /gr-/ conforms to the SSP since the first member in this cluster is less sonorous than the second member according to Parker's (2008) sonority scale in section 2.4. The initial /bg-/ cluster constitutes Plateau Sonority because both members are equally low in sonority, while Reverse Sonority occurs in the initial cluster /ʕʃ-/ because the first member /ʕ/, as a voiced fricative, is more sonorous than /ʃ/, as a voiceless fricative. The vowel deletion here that results in initial clusters appears to be a fast-speech phenomenon. These word-initial clusters occur in fast speech only and are not found in careful speech where vowels are found in the phonetic level. That suggests that vowel deletion–and subsequent onset clusters–occurs after the phonological evaluation (by the OT constraints) has occurred. This view is supported by the arguments of various scholars including Gay (1981), Munhall and Löfqvist (1992), Byrad and Tan (1996), and Kirby (2014) who agree that the disappearance of intrusive or excrescent vowels in fast speech has been observed in a number of languages as the result of an increase in the relative overlap of extant articulatory gestures. Thus, I would argue in this case that we are looking at a phonetic phenomenon, rather than one properly accounted for by the phonology. To account for such behavior using OT, the candidates of the input /ba.ga.ra/ 'cow' are evaluated in the next tableau.

(4.13) ONS>> *i]$_\sigma$>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO

/ba.ga.ra/	ONS	*i]$_\sigma$	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
☞ a. ba.ga.ra						
b. bga.ra				*!	*	
c. bag.ra				*!		

The tableau (4.13) shows candidate (a) as optimal due to the avoidance of the violation of the MAX-IO and *COMPLEX$_{ONS}$ constraints, whereas candidate (b), as the desired output, fails to satisfy these constraints. Candidate (c) is prevented from being optimal because it violates the MAX-IO constraint. Therefore, there must be a constraint that can determine candidate (a) as an optimal output. Consider the following constraint:

(4.14) *LLL
Assign one violation mark for three light syllables

The constraint in (4.14) will be ranked higher than the MAX-IO constraint in order to eliminate the output (a).

(4.15) ONS>>*LLL>>*i]$_\sigma$>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO

/ba.ga.ra/	ONS	*LLL	*i]$_\sigma$	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
a. ba.ga.ra		*!					
b. bga.ra					*	*!	
☞ c. bag.ra					*		

In the tableau (4.15), candidate (a) fails to be optimised due to the violation of the *LLL constraint. Candidate (b), as the desired output, satisfies this constraint but it cannot be optimal, whereas candidate (c) is shown as optimal. The *LLL constraint is not enough to determine candidate (b) as optimal. There must be another constraint than can eliminate candidate (c) from being optimal; the sonority in this candidate rises across the syllable boundary because [g] is less sonorous than [r]. In this case the constraint below is against this rising:

(4.16) Syllable Contact (SYLLCON) (Bat El 1996:302)

> The onset of a syllable must be less sonorous than the last segment in the immediately preceding syllable, and the greater the slope in sonority the better.

The constraint in (4.16) will be ranked higher than MAX and *COMPLEX$_{ONS}$ in the next tableau in order to eliminate candidate (c) from being optimal.

(4.17)

ONS>>*LLL>>SYLLCON>>*i]$_σ$>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO

/ba.ga.ra/	ONS	*LLL	SYLLCON	*i]$_σ$	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
a. ba.ga.ra		*!						
☞b. bga.ra					*	*	*	
c. bag.ra			*!			*		

The SYLLCON and *LLL successfully help to determine candidate (b) as optimal because these constraints are highly-ranked and they are violated by the candidates (a) and (c). The candidates of the input /ʕa.ʃa.ra/ 'ten' are evaluated in the next tableau.

(4.18)

ONS>>*LLL >>SYLLCON>>*i]$_σ$>>SSP>>MAX>>*COMPLEX$_{ONS}$>>DEP

/ʕa.ʃa.ra/	ONS	*LLL	SYLLCON	*i]$_σ$	SSP	MAX	*COMPLEX$_{ONS}$	DEP
a. ʕa.ʃa.ra		*!						
☞b. ʕʃa.ra						*	*	
c. ʕaʃ.ra			*!			*		

Candidate (b) is identified in the tableau (4.18) as optimal because it avoids the violation of The SYLLCON and *LLL constraints. Candidate (a) cannot be optimal since it violates the *LLL constraint. Candidate (c) avoids the violation of the same constraint by the deletion of a vowel in the penultimate syllable, but it fails to avoid the violation of the SYLLCON constraint.

The second phonological process that results in word-initial clusters in NA is CV-metathesis. This process is motivated by the existence of a non-emphatic guttural in the coda position of a non-final syllable. Consider the following examples:

(4.19) **Word-initial clusters in NA (CV-metathesis)**

a. /taʁ.ris/→[tʁa.ris] ‘she plants’
b. /gah.wa/→[gha.wa] ‘coffee’
c. /naχ.lah/→ [nχa.lah] ‘palm tree’

By virtue of the SSP, the word-initial cluster in (4.19a) does not constitute any type of SSP violation because the first member /t/ is less sonorous than /ʁ/, as the second member. However, the word-initial clusters in (4.19b-c) do not conform to the SSP since the first members of these clusters, being more sonorous than the members close to the nuclei, display Reverse Sonority. In the next tableau, the candidates of the input /taʁ.ris/ ‘she plants’ are evaluated, using OT analysis. The constraint which militates against metathesis is added to the next tableau.

(4.20) LINEARITY (Pater 1995:6)

S_1 reflects the precedence structure of S_2, and vice versa.

(4.21)

ONS>>*LLL >> SYLLCON >>*i]$_\sigma$>> >LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>> DEP-IO

/taʁ.ris/	ONS	*LLL	SYLLCON	*i]$_\sigma$	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
a. taʁ.ris			*!						
b. tʁa.ris					*!			*	
c. ta.ʁ**a**.ris.		*!							*
☹ d. tal.ris									

The tableau (4.21) shows candidate (d) as optimal since it satisfies all the constraints. Candidate (a) violates the SYLLCON due to rising sonority across the syllable boundary. Candidate (c) violates the *LLL constraint and candidate (b) violates the LINEARITY constraint. It is clear that the guttural [ʁ] in the non-final syllable in candidate (d) has disappeared, whereas it is preserved in other candidates. This is why this candidate is distinguished from the others. The following constraint can eliminate candidate (d) from being optimal:

(4.22)

*LENITION-GUTTRAL
The manner of articulation of gutturals should not be changed to a vowel-like (more sonorous) one.

The constraint in (4.22) in the next tableau will be ranked higher than the LINEARITY constraint in order to eliminate the output [tal.ris].

(4.23)

ONS>>*LLL>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>> DEP-IO

/taʁ.ris/	ONS	*LLL	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
a. taʁ.ris			*!							
☞ b. tʁa.ris						*			*	
c. ta.ʁ**<u>a</u>**.ris.		*!								*
d. tal.ris					*!					

Candidate (b) is successfully distinguished as optimal due to the satisfaction of highly-ranked constraints: i.e. *LLL, SYLLCON, and *LENITION-GUTTURAL. Candidate (d) fails to be optimal because it violates the *LENITION-GUTTURAL constraint. Candidate (c) violates the *LLL and candidate (a) violates the SYLLCON constraint. The candidates of the input /naχ.lah/ 'palm tree' are evaluated in the next tableau:

(4.24)

ONS>>*LLL>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>> DEP-IO

/naχ.lah/	ONS	*LLL	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO
a. naχ.lah			*!							
☞ b. nχa.lah						*			*	
c. na.χ**a**.lah		*!								*
d. nal.lah					*!					

The tableau (4.24) shows that candidate (b) is optimal since it avoids the violation of highly-ranked constraints including *LLL, SYLLCON, and *LENITION-GUTTURAL. Candidate (a) satisfies the *LLL constraint, but it violates the SYLLCON constraint due to rising across the syllable boundary. Therefore, this candidate is eliminated from being optimal. On the other hand, candidate (c) avoids the violation of the SYLLCON constraint by vowel epenthesis after a guttural /χ/, but it fails to avoid the violation of the *LLL constraint. Candidate (d) satisfies the constraints *LLL and SYLLCON. However, this candidate violates the *LENITION-GUTTURAL constraint and is thus prevented from being optimal.

To conclude, this section used an OT analysis to demonstrate how word-initial clusters are created in NA. These clusters are created by two phonological processes, deletion and CV metathesis. These processes are explained in depth in chapter 5. The coda in NA will be illustrated in the next section using OT.

4.6 The coda in NA

As discussed in sections 2.5 and 4.2, codas, either simple or complex, are allowed in most modern Arabic dialects, including NA. Unlike single onsets, single codas are optional since there are some syllable types in NA that lack codas, for example CV, CVV, CCV, and CCVV. In terms of OT, single codas in most modern Arabic dialects as well as NA violate the universal markedness constraint against closed syllables. This constraint is repeated in (4.25):

(4.25) *CODA (Prince and Smolensky 2004):
Syllables must not have codas.

On the other hand, two member complex codas that conform to the SSP are allowed in NA, whereas complex codas that violate the SSP are avoided by vowel epenthesis. However, there is an exceptional case where complex codas that violate the SSP are tolerated in order to preserve the lexical category of words; e.g., /χasˤm / ‘discount’ → [χasˤ**a**m] ‘he gave a discount’. This behaviour will be discussed in subsection 5.3.2.1.3. Consider the following examples:

(4.26) Word-final clusters that obey the SSP in NA

a. /bint/→ [bi**nt**] ‘a girl’

b. /ʕind/→ [ʕi**nd**] ‘it is with’

c. /bandʒ/→ [ba**ndʒ**] ‘anesthesia’

d. /bard/→ [ba**rd**] ‘cold’

e. /barg/→ [ba**rg**] ‘thunder’

f. /kalb/→ [ka**lb**] ‘dog’

Consonant clusters in words in (4.26) are permitted in NA since they conform to the SSP; hence, the first members of these clusters are more sonorous than the peripheral consonants. Therefore, sonority does not rise in the coda position. Complex codas in words in (4.27) violate the constraint below:

(4.27)

a. *COMPLEX$_{\text{CODA}}$ (Prince and Smolensky 1993)

A syllable must not have more than one coda segment.

Some word-final clusters that constitute Reverse Sonority are broken up by internal epenthesis which results in disyllabic words. Consider the following examples:

(4.28) Word-final clusters that violate the SSP

a./ħukm/→ [ħuk**u**m] ‘verdict’

b. /faħm/→ [faħ**a**m] ‘coal’

c. /baħr/→ [baħ**a**r] ‘sea’

d. /ħabl/→ [ħab**i**l] ‘rope’

e. /ʔakl/→ [ʔak**i**l] ‘eating’

f. /fadʒr/→ [fadʒ**u**r] ‘dawn’

e. /sˤabr/→ [sˤab**u**r] ‘patience’

The word-final clusters in the input in (4.28) violate the SSP because the peripheral consonants, as sonorants, are more sonorous than the consonants close to the nuclei. Therefore, the sonority rises in the coda position. This manner of violation motivates vowel epenthesis which occurs in the middle of the members of final consonant clusters to break these clusters up. Consequently, these words are changed from monosyllabic to disyllabic. This behavior will be addressed in subsection 5.3.2.1.2. In the current section, the final consonant clusters in NA will be accounted for using OT. The candidates of the input /bint/ ‘a girl’ are evaluated in the next tableau.

(4.29)

ONS>>*LLL>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>> DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

/bint/	ONS	*LLL	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a. ˈbint											*	**
b.ˈ bin.t**i̲**				*!						*		*
c. ˈbi.n**i̲**t										*!		*
d. ˈbin								*!				*

Candidate (a) in the tableau (4.29) is optimal since it avoids the violation of the MAX-IO and DEP-IO constraints, unlike the rest of the candidates. Candidate (d) avoids the violation of the *COMPLEX$_{CODA}$ constraint by the deletion of the last segment [t], but it fails to satisfy the MAX-IO constraint. Therefore, this candidate is prevented from being optimal. Candidates (b) and (c) avoid the violation of the *COMPLEX$_{CODA}$ by vowel epenthesis. However, candidate (b) is eliminated by the violation of the SYLLCON while the DEP-IO constraint causes the elimination of candidate (c). The candidates of the input /ʕind/ ‘it is with’ are evaluated in the next tableau:

(4.30)

ONS>>*LLL>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

/ʕind/	ONS	*LLL	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a. ʕind											*	**
b. ʕin.d**i**										*!		*
c. ʕi.n**i**d										*!		*
d. ʕin								*!				*

The tableau (4.30) identifies candidate (a) as optimal because it satisfies the faithfulness constraints MAX-IO and DEP-IO. Candidates (b) and (c) are eliminated from being optimal due to the violation of the DEP constraint. The MAX-IO constraint is violated by candidate (d). In the next tableau, I will evaluate the candidates of the input /ħukm/ ‘verdict’:

(4.31)

ONS>>*LLL>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>> DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

/ħukm/	ONS	*LLL	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ħukm							*!				*	**
b. ħuk.m**i**			*!							*		*
☞c. ħu.k**u**m										*		*
d. ħuk								*!				*

Candidate (c) is identified in the tableau (4.31) as optimal since it avoids the violation of highly-ranked constraints. The SSP constraint is avoided by the candidate (b) through peripheral epenthesis, but this epenthesis results in the violation of the SYLLCON constraint due to rising across the syllable boundary. The violation of the SSP is avoided by the deletion of the last consonant in candidate (b), but it results the violation of MAX-IO. Candidate (a) fails to be optimal due to the violation of the SSP. The candidates of the input /faħm/ 'coal' are evaluated in the next tableau:

(4.32)

ONS>>*LLL>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO >>*COMPLEX$_{CODA}$>>*CODA

/faħm/	ONS	*LLL	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. faħm							*!				*	**
b. faħ.m**i**			*!							*		*
☞c. fa.ħ**a**m										*		*
d. faħ								*!				*

Candidate (c) is shown in the tableau (4.32) as the optimal output since it avoids the constraints SYLLCON, SSP, and MAX-IO. These constraints are subject to violations by the candidates (a), (b), and (d). Candidate (a) satisfies the DEP-IO constraint by preserving the final consonant cluster, but it fails to satisfy the SSP constraint because the peripheral consonant, as the second member of the final consonant cluster, is more sonorous than the first member. Candidate (b) avoids the violation of the SSP by peripheral epenthesis, but it fails to satisfy the SYLLCON due to rising sonority across the syllable boundary. Candidate (d) satisfies the SSP constraint by the deletion of the final segment, but it is eliminated from being optimal because the deletion of the last segment results in the violation of the MAX-IO constraint.

To conclude, the types of codas in NA are illustrated in this section using OT. This dialect violates the universal markedness constraint (*CODA). Complex codas that conform to the SSP are permitted in this dialect, whereas those which violate the SSP are broken up by vowel epenthesis. In terms of OT, complex codas in NA violate the universal markedness constraint (*COMPLEX$_{CODA}$). Word-final clusters in this dialect are underlying; these clusters are not created by syncope or CV-metathesis. Word-initial clusters, as discussed in section (4.5), result from deletion and CV-metathesis, and are not found in MSA; this is the answer to the question regarding the source of consonant clusters in NA.

Now that onsets and codas in NA have been analysed, stress and syllable weight in this dialect will be addressed in the next section.

4.7 Stress and Syllable Weight in NA: Light vs. Heavy

This section presents data showing the moraic weight of the syllables in NA. The word stress patterns in NA are closed to stress patterns in CA that are introduced by Al-ani (1970; see subsection 2.2.1). Consider the following stress parameters in NA:

(4.34) **Stress parameters in NA**

I) the ultimate syllable (final syllable) receives stress if it is either CVVC or CVCC.

a. CVC.'CVVC → [mak.'tu:b] 'written'

b. CVC.CV.'CVCC → [ʔin.ʕa.'raft] 'I became known'

II) Stress falls on the penultimate syllable if it is heavy when the ultimate syllable is neither CVVC nor CVCC.

a. CVC.'CVV.CVC → [mak.'tu:.fah] 'tied (fm. sg.)'

b. CVC.'CVC.CV→ [ga.'bal.na] 'meet us (m.s.)'

III) The antepenultimate syllable receives stress if the penultimate syllable is not heavy, and if the ultimate syllable is neither CVVC nor CVCC.

a. 'CVC.CV.CVC→ ['ʔin.ki.sar] 'it (ms. sg.) got broken'

IV) In disyllabic words, stress falls on the penultimate syllable if the ultimate syllable is neither CVVC nor CVCC.

a. 'CV.CVC→ ['ki.tab] 'he wrote'

b. 'CCV.CV→ ['bga.ra] 'cow'

V) Stress is never assigned before the antepenultimate syllable.

VI) Geminated consonants do not generally occur in the final syllable in disyllabic words in NA. As a result, geminates undergo degemination and the stress is received by the preceding syllable (regression of stress); e.g., /ji.ˈmidd/→ degemination→ [ˈji.mid] ‘he spreads’.[38]

Based on stress parameters in NA, the CV syllable is stressed in the penultimate position if the final syllable is either CV or CVC. The CVV syllable is stressed in the antepenultimate position of the penultimate and final syllables are light. The CVC syllable is stressed in the antepenultimate position if the penultimate and final syllables are light. Consider the following examples:

(4.35)

(I) Stressed CV syllables.

a. [ˈkti.bu] ‘they wrote’

b. [ˈħa.ʃa.ra] ‘insect’

c. [ˈra.ma] ‘he threw’

d. [ˈma.li.ka] ‘queen’

(II) Stressed CVV syllables

a. [mak.ˈtuu.fah] ‘tied (fm. sg.)’

b. [ˈʤaa.bu.na] ‘they brought us’

(III) Stressed CVC syllables

a. [ga.ˈbal.na] ‘meet us (m.s.)’

b. [ˈmak.tab] ‘an office’

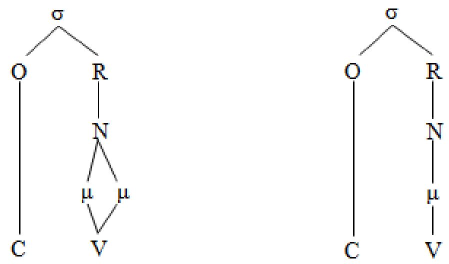
c. [ˈmak.ta.bah] ‘library’

According to the stress parameters in (4.34) and examples in (4.35), the weight of the CV syllable never changes regardless of its position. In other words, the weight of the CV syllable is light whether this syllable is stressed or not. Unlike CV syllables, as mentioned in section 4.3, there is a restriction on the position of the CVV syllable: this syllable is not found in word-final position, whereas it might be found in the penultimate or antepenultimate as a heavy syllable since it is bimoraic, as shown in the representation below:

[38] Prochazka (1988) notes that this behaviour is found in some Saudi Arabic dialects like Tanuumah, Bal-Qarn, Rawili, Hayli, alqassim, and Riyadh.

(4.36) **<u>The representations of the CVV and CV syllables</u>**

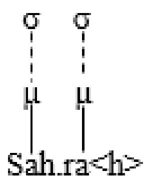
a. CVV b. CV



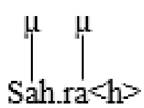
CVC syllables are considered to be heavy in the non-final positions and light in the final position. The final CVC becomes light since the last consonant achieves the requirements for the assignment of extrametricality as explained in subsection (2.5.1), whereas the unstressed CVC in the non-final position is not light due to the peripherally condition which says that a constituent can be extrametrical if it is on the edges. This means that the final C in the non-final CVC cannot be extrametrical since it is not on the right edge of the prosodic word. Furthermore, by applying weight-by-position, the last consonant in non-final CVC should be moraic. In subsection 2.5.1, an algorithm was described which Clements (1990) and Watson (2002) use to show the assignment of extrametricality and weight-by–position rule. This algorithm is exemplified in the syllabification of the word '*sah.rah* 'soiree'.

(4.37)

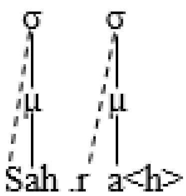
a. final consonant extrametricality



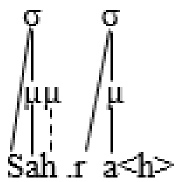
b. Association of moraic segments to a syllable node



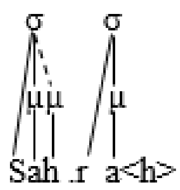
c . Association of onset to syllable node



d. Assignment of mora through Weight-by-Position



e. adjunction of Weight-by-Position mora to syllable node



f. incorporation of extrametrical consonant into preceding syllable

Based on the exemplified algorithm in (4.37), light and heavy CVC syllables are distinguished: the final unstressed CVC is light because the last consonant is deemed extrametrical (weightless) and this syllable becomes monomoraic. The non-final CVC is considered to be heavy where its last consonant does not undergo the extrametricality rule, whereas this consonant is evaluated according to the weight-by-position rule: i.e. this syllable is bi-moraic. The following constraints are used to evaluate the final and non-final CVC syllables:

(4.38) Final CVC

ONS>>*LLL>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/CVC/	ONS	*LLL	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ a. CVC												*
μ b. CVC												*
μ c. CV								*!				

The tableau (4.38) does not determine the optimal candidate of the input /CVC/. Candidate (c) violates the MAX-IO constraint, whereas candidates (a) and (b) equally violate the *CODA constraint. In order to eliminate candidate (a) from being optimal, it is very important to use the following constraint:

(4.39)

*FINAL-C-μ (Hayes 1989):
Word-final coda consonants are weightless.

The constraint in (4.39) must be ranked higher than the *CODA constraint in order to determine the candidate (b) as optimal. Consider the following tableau:

(4.40) **Final CVC syllables in NA**

ONS>>*LLL>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ>> *COMPLEX$_{ONS}$ >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/CVC/	ONS	*LLL	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ a. CVC									*!				*
μ ☞ b. CVC													*
μ c. CV								*!					

The *FINAL-C-μ constraint is very useful to determine the optimal candidate in the tableau (4.41). This constraint is violated by candidate (a) since the last consonant is moraic. Therefore, this candidate is prevented from being optimal. Candidate (c) satisfies the same constraint by the deletion of the last consonant, but it fails to avoid the violation of the MAX-IO constraint. Consequently, candidate (b) becomes optimal. Candidates of non-final /CVC/ are accounted for using OT in the next tableau:

(4.41) **Non-Final CVC syllables in NA**

ONS>>*LLL>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/CVC/	ONS	*LLL	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ a. CVC													*
μ b. CVC													*
μ c. CVC								*!					

The set of constraints in (4.41) do not identify the optimal candidate of the non-final CVC in NA since candidates (a) and (b) both violate the *CODA constraint. The following constraint plays a role in determining the optimal candidate in (4.42):

(4.42)

MAX-μ-IO (McCarthy & Prince 1995, Moren 1999)

Every mora in S_1 has a correspondent in S_2 (no deletion of moras).

The constraint in (4.42) must be ranked higher than the *CODA constraint in order to determine the optimal candidate of the non-final CVC syllable in NA. Consider the following tableau:

(4.43) **Non-Final CVC syllables in NA**

ONS>>*LLL>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/CVC/	ONS	*LLL	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a. CVC														*
μ b. CVC										*!				*
μ c. CV								*!		*				

Candidate (a) is optimal in the tableau (4.43) because it avoids the violation of the MAX-IO and MAX-μ-IO constraints, whereas these constraints are violated by candidates (b) and (c): candidate (b) fails to be optimal due to the violation of the MAX-μ-IO constraint. Both the MAX-IO and MAX-μ-IO constraints are violated by candidate (c). In the next tableau, I will evaluate the candidates of the input /ˈga.lam/ ‘pen’:

(4.44) ONS>>*LLL>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ>>MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈga.lam/	ONS	*LLL	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a. ˈga.lam										*				*
μ μμ b. ˈga.lam									*!					*
μ μ c. ˈga.la								*!		*				

In tableau (4.44), candidate (a) is optimal because this candidate successfully avoids the violation of the MAX-IO and *FINAL-C-μ constraints. The MAX-IO constraint is violated by candidate (c). Candidate (b) preserves the final C in the final syllable but this candidate fails to be optimal due to the moraic coda in the final syllable that violates the *FINAL-C-μ constraint. In the next two tableaux, I will evaluate the candidates of the input /ki.tab/‘he wrote’ and /ʤi.maʕ/ ‘he gathered’ in order to check whether the set of constraints in (4.44) can identify optimal outputs. The next tableau shows an OT analysis of the candidates of the input /ˈki.tab/‘he wrote’.

(4.45)

ONS>>*LLL>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ>>MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈki.tab/	ONS	*LLL	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a.ˈki.tab										*				*
μ μμ b.ˈki. tab									*!					*
μ μ c.ˈki.ta								*!		*				

Candidate (a) in the tableau (4.45) is identified as optimal due to the satisfaction of the MAX-IO, *FINAL-C-μ constraints. Candidate (b) avoids the violation of the MAX-μ-IO constraint by preserving the moraic coda which triggers the violation of the FINAL-C-μ constraint. Candidate (c) fails to be optimal due to the violation of the MAX-IO constraint. In the next tableau, I will evaluate the candidates of the input /ˈʤi.maʕ/ ‘he gathered’:

(4.46)

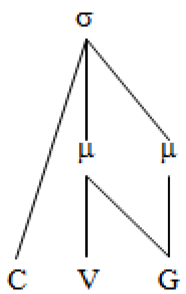
ONS>>*LLL>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈʤi.maʕ/	ONS	*LLL	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a.ˈʤi.maʕ										*				*
μ μ μ b.ʤi.maʕ									*!					*
μ μ c.ˈʤi.ma								*!		*				

The tableau (4.46) identifies candidate (a) as optimal due to the avoidance of the MAX-IO and *FINAL-C-μ constraints, unlike candidates (b) and (c). Candidate (b) preserves the word-final coda which is moraic in order to satisfy the constraints MAX and MAX-μ-IO but this preservation results in the violation of the *FINAL-C-μ constraint. Candidate (c) satisfies the*FINAL-C-μ constraint by the deletion of the moraic coda in the final syllable, but this candidate fails to be optimal due to the violation of the MAX-IO constraint.

Non-final CVG syllables in NA are considered to be bimoraic since the members of the geminate are directly linked to one mora, as shown in the representation in (4.47):

(4.47)



In NA, there are two types of geminates: the tautosyllabic geminate (inseparable) and the heterosyllabic geminate (inalterable). Tautosyllabic geminate’s members share one mora (Watson 2007). Consider the following examples:

(4.48) **<u>Tautosyllabic geminate in NA</u>**

a. /ʕamm-na/→ [ʕamm.na] ‘our uncle’

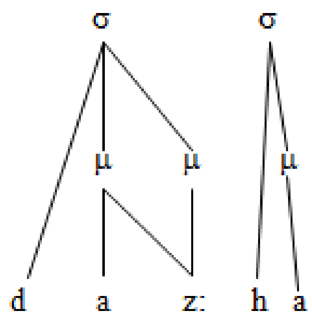
b. /dazz-ha/→ [dazz.ha] ‘he pushed it (f. sg.)’

c. /hamm-ha/→ [hamm.ha] ‘her concern’

d. /madd-ha/→ [madd.ha] ‘he extended it (f. sg.)’

The non-final syllables in examples in (4.48) are heavy since the members of the tautosyllabic geminate are directly linked to one mora; i.e. the second member of a geminate is not a semisyllable. The representation of the output [dazz.ha] ‘he pushed it (f. sg.)’ is shown below:

(4.49) **<u>The representation of the output [dazz.ha]</u>**



The second type of geminate in NA is known as a heterosyllabic geminate (inalterable) where the first member is resyllabified as the coda of the preceding syllable while the second member is resyllabified as the onset of the following syllable which lacks an onset. This type of geminate can be found in disyllabic words that are associated with vowel-initial suffixes:

(4.50) **<u>Heterosyllabic geminate in NA</u>**

a. /ʕamm-i/ → [ʕam.mi] ‘my uncle’

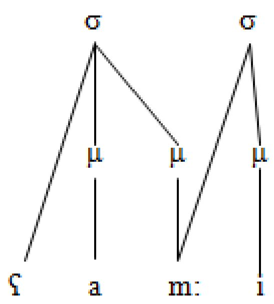
b. /dazz-u/→ [daz.zu] ‘they pushed’

c. /hamm-ah/→ [ham.mah] ‘his concern’

e. /madd-u/→ [mad.du] ‘they extended’

Clearly, due to the attachment of a vowel-initial suffix, the members of a geminate in (4.50) are resyllabified to different syllables: i.e. the first member of the geminate is a coda of the preceding syllable while the second member is an onset of the following syllable where a vowel-initial suffix is employed as its nucleus. The representation of the output [ʕam.mi] ‘my uncle’ is shown below:

(4.51) **<u>The representation of the output [ʕam.mi] ‘my uncle’</u>**



To account for non-final CVG using OT, the next tableau analyses the candidates of the input /ʕamm-na/ ‘our uncle’.

(4.52)

ONS>>*LLL>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>>*COMPLEX$_{CODA}$ >>*CODA

/ʕamm-na/	ONS	*LLL	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈʕam:. na													*	**
μ μμ μ b. ˈʕam:.na													*	**
μμ μ c. ˈʕam.na								*!		*				*
μ μμ μ d. ʕa.ˈmi̲m.na												*!		*

The tableau (4.52) did not determine the optimal candidate of the input /ʕamm-na/ because candidates (a) and (b) both violate the *COMPLEX$_{CODA}$ constraint as well as the *CODA constraint. By shedding light on the difference between candidates (a) and (b), we can easily come up with a constraint that can identify the following differentiate between these candidates: the non-final syllable in the candidate (a) is bimoraic, whereas the one in candidate (b) is trimoaic. Consider the following constraint:

(4.53)

*3μ (Kager 1999):

No trimoraic syllables.

The constraint (4.53) in the next tableau is ranked higher than *FINAL-C-μ, MAX-IO, and $\text{COMPLEX}_{\text{CODA}}$ in order to eliminate any candidate that has a trimoraic syllable.

(4.54)

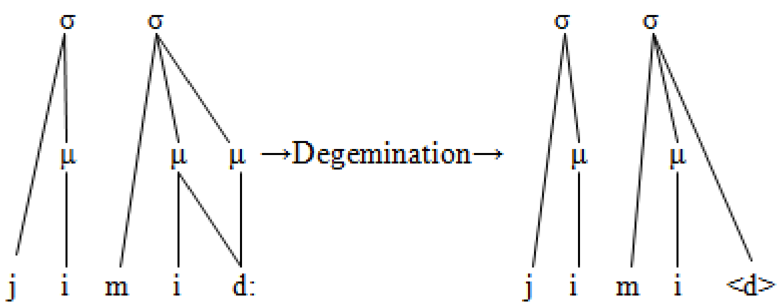
ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-Cμ>> MAX-μ-IO >>*$\text{COMPLEX}_{\text{ONS}}$>>DEP-IO>> *$\text{COMPLEX}_{\text{CODA}}$ >>*CODA

/ʕamm-na/	ONS	*LLL	*3μ	SYLLCON	*i]$_\sigma$	LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*$\text{COMPLEX}_{\text{ONS}}$	DEP-IO	*$\text{COMPLEX}_{\text{CODA}}$	*CODA
μ μ μ ☞ a. ˈʕam:.na														*	**
μ μμ μ b.ˈʕam:.na			*!											*	**
μμ μ c.ˈʕam.na									*!		*				*
μ μμ μ d. ʕa.ˈmi̱m.na													*!		*

The *3μ constraint determines the candidate (a) as the optimal output of the input /ʕamm-na/ while the same constraint is violated by candidate (b). Therefore, this candidate is eliminated from being optimal. Candidate (c) fails to be optimal due to the violation of the MAX-IO constraint. Likewise, candidate (d) is prevented from being optimal because this candidate violates the DEP-IO constraint.

There is a restriction on CVG syllables in disyllabic words: this type of syllable is not found in the final position, according to the stress rule (VI). In other words, in disyllabic words, geminates in final syllables are targetes of degemination. As a result, a degeminated constituent becomes extrametrical and the stress shifts to a non-final syllable (regression of stress); e.g., /ji.ˈmidd/→ degmination→ [ˈji.mid] ‘he spreads’. The representation of the output [ˈji.mid] is shown below:

(4.55) The representation of the output [ˈji.mid] ‘he spreads’



This behavior is accounted for using OT. In the next tableau, I will evaluate the candidates of the input /ji.ˈmidd/ ‘she spreads’.

(4.56)

ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>MAX-IO>>*FINAL-C-μ >>MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ji.ˈmidd/	ONS	*LLL	*3μ	SYLLCON	*i]$_\sigma$	LENITION-GUTTURAL	LINEARITY	SSP	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ji.ˈmid									*!	*				*	*
μ μ b. ˈji mid									*!		*			*	*
μ μμμ c .ji.mid:			*!							*				*	**
μ μμ ☹ d. ji. ˈmid										*					**

Candidate (d) is incorrectly determined as optimal because it satisfies the *3μ and MAX-IO constraints. Candidate (c) avoids the violation of the MAX-μ-IO constraint by preserving the final moraic consonant, but this candidate fails to avoid the violation of the *3μ constraint due to the final trimoraic syllable. Therefore, this candidate fails to be optimal. Candidates (a) and (b) cannot be optimal due to the violation of the MAX-IO constraint. In order to optimize candidate (b), there must be a constraint that helps to eliminate the candidate (d). I introduce the following constraint to do this job:

(4.57)

*FINAL-G

Word-final geminates are prohibited.

The constraint in (4.57) must be ranked in the following tableau higher than MAX-IO in order to eliminate the candidate (d) from being optimal.

(4.58)

ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*FINAL-G>>MAX-IO>>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ji.ˈmidd/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ji.ˈmid										*	*!				*	*
μ μ ☞ b. ˈji mid										*		*			*	*
μ μμμ c .ji.ˈmid:			*!						*		*				*	**
μ μμ d. ji.ˈmid									*!		*					**

The tableau (4.58) identifies candidate (b) as optimal since it avoids the violation of the *3μ and *FINAL-G constraints. These constraints are violated by candidates (c) and (d): the candidate (c) violates the *3μ constraint due to the final trimoraic syllable. The *FINAL-G constraint against geminate at the end of the word is violated by candidate (d). Candidate (a) avoids the violation of the *FINAL-G constraint by degemination but fails to avoid the violation of the *FINAL-C-μ due to the moraic word-final coda.

To conclude, the relation between stress and weight of the syllable has been demonstrated in this section. The final unstressed CVC is considered to be heavy because the final consonant in this syllable is assigned as extrametrical, while the non-final unstressed CVC syllable is heavy since the last consonant of this syllable is not extrametrical. The reason for not assigning the last consonant as extrametrical in this syllable is due to the peripherality condition, as one of the restrictions on extrametricality introduced by Hayes (1995). The non-final CVG in NA is heavy since the members of the geminate are directly linked to one mora, whereas the word-final geminate at the end of the prosodic word is prohibited. Therefore, this geminate is the target of degemination and the last consonant is assigned as extrametrical. Consequently, the stress assignment shifts to the preceding syllable; e.g., /ji.ˈmidd/→ degmination→ [ˈji.mid] ‘he spreads’. The next section is about the treatment of superheavy syllables in NA.

4.8 Superheavy Syllables in NA

In the previous section, syllables of the forms CVC and CVG were distinguished in terms of their weight. The final unstressed CVC syllable is light because its last consonant is assigned as extrametrical (weightless), i.e. it meets the peripherality condition (Hayes 1995).The CVG syllable is heavy (bimoraic) in the non-final position since the members of geminate share one mora. However, this syllable is not tolerated in the word-final position; this geminate undergoes degemination. Consequently, the last consonant is assigned as extrametrical and stress is received by a non-final syllable. The maximal syllable weight is bimoraic in Najdi; trimoraic syllables are not allowed. Final syllables of the form CVVC and CVCC are superheavy syllables in NA because they consist of heavy syllables preceded by degenerate syllables. The same syllables in the non-final position are deemed superheavy because they consist of heavy syllables plus semisyllables. In this section, I will shed light on the treatments of CVCC and CVVC syllables in this dialect and the role of OT in the analysis of these syllables. The next subsection is devoted to analysing final superheavy syllables in NA.

4.8.1 Final Superheavy Syllables in NA

In subsection 2.5.1, I explained that scholars including Aoun (1979), Selkirk (1981), Broselow (1992), Kenstowicz (1994), Farwaneh (1995), Hayes (1995), Kager (1995b), McCarthy (2007), and Watson (2007) provide different treatments of final superheavy syllables of the forms CVVC and CVCC. Aoun (1979), Selkirk (1981), Kenstowicz (1994), Hayes (1995), Kager (1995b) agree that the final C in the word-final CVVC and CVCC syllables is extrasyllabic. Broselow (1992) and Watson (2007) state that mora sharing is applied to the final C in the word-final CVVC, i.e. the final consonant in this syllable shares its mora with the preceding vowel. Farwaneh (1995) and McCarthy (2007) note that the final consonants in the syllable form CVCC are directly linked to one mora. However, I disagree with the idea that mora sharing is applied to the final C in the word-final CVVC and CVCC because extrasyllabicity and extrametricality notions are conditioned by the peripheral segments (Iverson 1990), i.e. the peripheral consonants in the syllable forms CVV**C** and CVC**C** are extrametrical if these syllables are unstressed, while the peripheral consonants in the same syllables are extrasyllabic if these syllables are stressed. In NA, the last consonants in the syllables forms CVC**C** and CVV**C** are deemed extrasyllabic for two reasons: firstly, the last consonants in the syllable forms CVV**C** and CVC**C** achieve the peripherality condition. Secondly, according to stress paramters in NA identified in section 4.7, syllables of the forms CVVC and CVCC are restricted to the word-final position as stressed syllables. Consider the following examples:

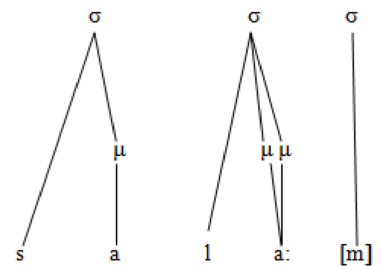
(4.59) **Word-final Superheavy Syllables in Najdi**[39]

a. /sa.ˈla:.m/→ [sa.ˈla:.m] ‘peace’
b. /ʔa.ˈgu:.l/→ [ʔa.ˈgu:.l] ‘I say’
c. /ma.ˈgil.t/→ [ma.ˈgil.t] ‘I did not say’

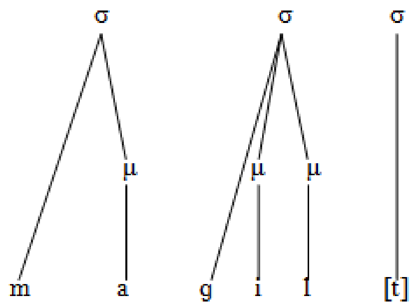
The examples in (4.59) show that the final C in the outputs in (a), (b), and (c) is extrasyllabic because the final syllables are stressed. This extrasyllabicity means that trimoraic syllables in NA are not permitted. Consider the representation of the outputs [sa.ˈla:.m] ‘peace’ and [ma.ˈgil.t] ‘I did not say’.

(4.60)

a. [sa.ˈla:.m] ‘peace’



b. [ma.ˈgil.t] ‘I did not say’



[39] The unstressed short vowels in non-final light syllables do not undergo syncope since they are in words that are governed by SA phonology. This behaviour is discussed in detail in section 5.5.

The candidates of the input /sa.ˈla:m/ ‘peace’ and /ma.ˈgilt/ ‘I did not say’ are evaluated using OT in the next two tableaux:

(4.61) ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*FINAL-G>>MAX-IO >>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/sa.ˈla:.m/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP	*COMPLEX$_{CODA}$	*CODA
μ μμ ☞ a. sa. ˈla:.m																
μ μμμ b. sa.ˈla:m			*!								*					*
μ μμ c. sa. ˈla:.m											*!					*
μ μ d. ˈsa. la<m>										*!		*				*

Candidate (a) is identified in tableau (4.61) as optimal since it avoids the violation of highly-ranked constraints as well as low-ranked constraints. The *3μ constraint is violated by candidate (b) due to the final trimoraic syllable. Candidate (c) avoids the violation of the *3μ constraint through mora sharing of the final consonant with the preceding vowel, but this candidate fails to satisfy the *FINAL-C-μ constraint. The violation of the same constraint is avoided by candidate (d) by long vowel shortening and the extrametricality assignment of the final consonant. However, long vowel shortening in this candidate results in the violation of the MAX-IO constraint. The candidates of the input /ma.ˈgilt/ ‘I did not say’ are analysed in the next tableau:

(4.62)

ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*FINAL-G>>MAX-IO>> *FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ma.ˈgil.t/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ ☞ a.ma.ˈgilt															*	**
μ μμμ b. ma.ˈgilt			*!												*	**
μ μ μ c. ˈma. gi.li<t>					*!											*
μ μμ μ d. ˈma. gi l.t i					*!											*

The tableau (4.62) shows that candidate (a) is optimal because it avoids the violation of most of constraints, especially the *3μ and DEP-IO constraints. The *3μ constraint is violated by candidate (b). Therefore, this candidate is prevented from being optimal. Candidates (c) and (d) fail to be optimal due to the violation of the DEP-IO constraint.

To conclude, this subsection reveals the treatment of final superheavy syllables in Najdi as heavy syllables followed by degenerate syllables (extrasyllabic consonants), i.e. the final C is extrasyllabic in the final CVC**C** as well as the final C in the final CVV**C**. What if these syllables are found in the non-final position? Are the last consonants in the non-final CVCC and CVVC assigned as semisyllables? These questions will be addressed in detail in the next subsection which focuses on non-final superheavy syllables in NA.

4.8.2 Non-final Superheavy Syllables in NA

In the previous subsection, the final superheavy syllables in NA were analysed. These syllables are bimoraic since their last consonants are assigned as extrasyllabic consonants due to the peripherality condition. This shows that syllables in NA are maximally bimoraic. As discussed in subsection 2.5.2, superheavy syllables in SA in non-final positions are followed by semisyllables. Semisyllables are moraic consonants that are not affiliated to the syllable node. Semisyllables are not permitted in NA and they can be affiliated to the syllable node by one of two processes: mora sharing or vowel epenthesis. Mora sharing is used to avoid this moraic syllable if the non-final syllable has a long vowel. Consider the following examples:

(4.63) <u>**Non-final CVVC Syllables in Najdi**</u>

a. /be$_{\mu}$e$_{\mu}$.t$_{\mu}$.hu$_{\mu}$m/→ [be$_{\mu}$e$_{\mu}$t.hu$_{\mu}$m] ‘their house’

b. /be$_{\mu}$e$_{\mu}$.t$_{\mu}$.na$_{\mu}$/→ [be$_{\mu}$e$_{\mu}$t.na$_{\mu}$] ‘our house’

c. /ʃa$_{\mu}$a$_{\mu}$.f$_{\mu}$.na$_{\mu}$/→ [ʃa$_{\mu}$a$_{\mu}$f.na$_{\mu}$] ‘he saw us’

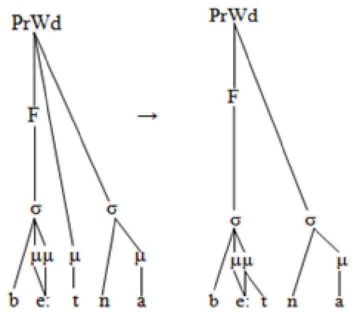
d. /ʃa$_{\mu}$a$_{\mu}$.f$_{\mu}$.hu$_{\mu}$m/→ [ʃa$_{\mu}$a$_{\mu}$f.hu$_{\mu}$m] ‘he saw them’

e. /ʤa$_{\mu}$a$_{\mu}$.b$_{\mu}$.hu$_{\mu}$m/→[ʤa$_{\mu}$a$_{\mu}$b.hu$_{\mu}$m] ‘he brought them’

f. /ʤa$_{\mu}$a$_{\mu}$.b$_{\mu}$.na$_{\mu}$/→ [ʤa$_{\mu}$a$_{\mu}$b.na$_{\mu}$] ‘he brought us’

The semisyllables in the sets of the input in (4.63) are affiliated to the syllable nodes by mora sharing in the outputs; semisyllables do not exist in the outputs. Consider the representation of the output [be$_{\mu}$e$_{\mu}$t.na$_{\mu}$] ‘our house’:

(4.64) <u>**The representation of the output [be$_{\mu}$e$_{\mu}$t.na$_{\mu}$] ‘our house’**</u>



The behaviour is accounted for using OT; the candidates of the input /ʤa$_{\mu}$a$_{\mu}$.b$_{\mu}$.hu$_{\mu}$m/ ‘he brought them’ are analysed in the next tableau:

(4.65) ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*FINAL-G>>MAX-IO >>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

/ʤa:$_{\mu\mu}$.b$_\mu$.hu$_\mu$m/	ONS	*LLL	*3μ	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ a. ʤa:b. hum			*!													*
μμ μ ☞ b. ʤa:b.hum																**
μμ μ c. ʤab.hum										*!		*				**
μμ μ μ d. ʤa:.bi.hum					*!											*

Candidate (b) is identified as optimal among these candidates because it avoids the violation of most of the constraints. Candidate (a) fails to be optimal due to the violation of the *3μ constraint. Candidate (c) avoids the violation of the same constraint by shortening a long vowel but it cannot satisfy the MAX-IO constraint as well as the MAX-μ-IO constraint. Vowel epenthesis is used by candidate (d) in order to satisfy the *3μ constraint but it fails to avoid the violation of the *i]$_\sigma$ and DEP-IO constraints.

Mora sharing is blocked in NA when dealing with the non-final superheavy syllable of the form CVCC. In subsection 2.5.1, Farwaneh (1995) and McCarthy (2007) state that the final consonant cluster in this type of syllable can share one mora if they comply with the SSP. However, this rule is not applied to NA especially the non-final CVCC that is associated with a consonant-initial suffix. Vowel epenthesis is used instead in this case in order to affiliate a semisyllable to a syllable node. Consider the following examples:

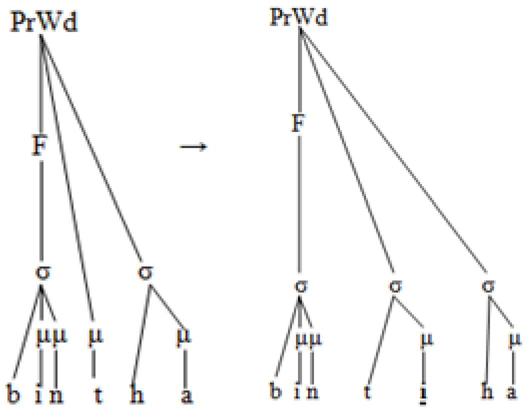
(4.66) **<u>Non-final CVCC Syllables in Najdi</u>**

a. /bi$_\mu$n$_\mu$.t$_\mu$-ha$_\mu$/→ [bi$_\mu$n$_\mu$.t**i**$_\mu$.ha$_\mu$] 'her daughter'

b. /gi$_\mu$l$_\mu$.t$_\mu$-ha$_\mu$/→ [gi$_\mu$l$_\mu$.t<u>**i**</u>$_\mu$.ha$_\mu$] 'I said it (s. sg.)'

The semisyllables in the input in (a) and (b) are avoided by vowel epenthesis rather than mora sharing in the output. This behaviour is shown in the representation of the output [bi$_\mu$n$_\mu$.t**i**$_\mu$.ha$_\mu$] 'her daughter'.

(4.67) **The Representation of the output [$bi_{\mu}n_{\mu}.ti_{\mu}.ha_{\mu}$] 'her daughter'**



OT is used to account for this behaviour. The candidates of the input /$bi_{\mu}n_{\mu}.t_{\mu}$-ha_{μ}/ 'her daughter' are evaluated in the next tableau:

(4.68) ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*FINAL-G>>MAX-IO >>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/$bi_{\mu}n_{\mu}.t_{\mu}$-ha_{μ}/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP	*COMPLEX$_{CODA}$	*CODA
μμμ μ a. bint. ha			*!	*											*	**
μ μμ μ b. bi. n **i** t. ha				*!	*									*		*
μμ μ μ ☞c. bin.t**i**. ha					*									*		*
μμ μ d. bint. ha				*!											*	**

The tableau (4.68) selects candidate (c) as optimal because this candidate satisfies the *3μ and SYLLCON constraints. These constraints are violated by candidates (a), (b), and (d). Candidate (a) has a non-final trimoraic syllable which violates the *3μ constraint. Therefore, this candidate is eliminated from being optimal. Candidates (b) and (c) are not identified as optimal due to the violation of the SYLLCON constraint.

To conclude, the treatment of non-final superheavy syllables of the forms CVCC and CVVC was demonstrated in this subsection. These syllables are avoided in the non-final position either by vowel epenthesis or mora sharing. The non-final superheavy syllable of the form CVVC is avoided by mora sharing; hence, a semisyllable shares a mora with a long vowel in the non-final syllable. This process is blocked when dealing with the non-final superheavy syllable of the form CVCC. Vowel epenthesis is used instead to avoid such a syllable. These phenomena are accounted for using OT; i.e. the *3μ constraint is used to ban any output with a trimoraic syllable and the SYLLCON constraint is to avoid rising sonority across the syllable boundary. In subsection 5.3.3, the non-final superheavy syllables CVVC and CVCC will be explained as motivators for internal epenthesis in NA. The next section considers the insights about syllable structure in NA that can be gained through OT.

4.9 The Unified Set of Constraints

In this section, the set of OT constraints that can account for syllable structure in NA are considered in order to answer the question of what insights about NA syllable structure processes can be gained through OT. Consider the following tableax:

(4.69) **The Unified set of constraints in NA syllable structure**

ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*FINAL-G>>MAX-IO >>*FINAL-C-μ>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ħi.ˈba:l/	ONS	*LLL	*3μ	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ a. ħi.'ba:.l					*!											*
μμ ☞b. ħba:.l								*		*		*	*			*
μμ μμ c. iħ.'ba:.l	*!			*			*			*		*		*		**

/ru.ˈfu:f/	ONS	*LLL	*3μ	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ a. ru.'fu:.f					*!											*
μμ ☞b. rfu:.f								*		*		*	*			*
μμ μμ c. i r.'fu:.f	*!						*									**

/ˈba.ga.ra/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈba.ga.ra		*!														
μ μ ☞b. ˈbga.ra								*		*		*	*			
μμ μ c. ˈbag.ra				*!												*

/ˈʕa.ʃa.ra/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈʕa.ʃa.ra		*!														
μ μ ☞b. ˈʕʃa.ra								*		*		*	*			
μμ μ c. ˈʕaʃ.ra				*!												*

/ˈtaʁ.ris/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ a.ˈtaʁ.ris				*!												**
μ μ ☞ b.ˈtʁa.ris							*						*			*
μ μ μ c.ˈta.ʁ**a**.ris.		*!												*		*
μμ μ d.ˈtal.ris						*!										*

/ˈnaχ.lah/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ a. ˈnaχ.lah				*!												**
μ μ ☞ b. ˈnχa.lah							*						*			*
μ μ μ c. ˈna.χ**a**.lah		*!														*
μμ μ d. ˈnal.lah						*!										**

/ˈbint/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ ☞a. ˈbint															*	**
μμ μ b. ˈbin.t**i**					*!									*		*
μ μ c. ˈbi.n**i**t														*!		*
μμ d. ˈbin										*!	*					*

/ˈʕind/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ ☞ a. ˈʕind															*	**
μμ μ b. ˈʕin. d**i**														*!		*
μ μ c. ˈʕi.n**i**d														*!		*
μμ d. ˈʕin										*!	*					*

/ˈħukm/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ a. ˈħukm								*!							*	**
μμ μ b. ˈħuk.m**<u>i</u>**				*!										*		*
μ μ ☞ c. ˈħu.k**<u>u</u>**m														*		*
μμ d. ˈħuk										*!	*					*

/ˈfaħm/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ a. faħm								*!							*	**
μμ μ b. faħ.m**<u>i</u>**				*!										*		*
μ μ ☞c. fa.ħ**<u>a</u>**m														*		*
μμ d. ˈfaħ										*!	*					*

Final /CVC/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ a. CVC											*!					*
μ ☞ b. CVC												*				*
μ c. CV										*!						

Non-final /CVC/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a. CVC																*
μ b. CVC												*!				*
μ c. CV										*!		*				

/ˈga.lam/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a. ˈga.lam												*				*
μ μμ b. ˈga.lam											*!					*
μ μ c. ˈga.la										*!		*				

/ˈki.tab/	ONS	*LLL	*3μ	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a.ˈki.tab												*				*
μ μμ b.ˈki. tab											*!					*
μ μ c.ˈki.ta										*!						

/ˈʤi.maʕ/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ ☞ a.ˈʤi.maʕ												*				*
μ μ μ b.ʤi.maʕ											*!					*
μ μ c.ˈʤi.ma										*!						

/ʕam:-na/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ ☞ a. ˈʕam:. na															*	**
μ μμ μ b.ˈʕam:.na			*!												*	**
μμ μ c.ˈʕam.na										*!		*				*
μ μμ μ d. ʕa.ˈmi̲m.na														*!		*

/ji.ˈmid:/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ a. ji.ˈmid										*	*!					*
μ μ ☞ b. ˈji mid										*		*				*
μ μμμ c .ji.mid:			*!					*	*		*				*	**
μ μμ d. ji.ˈmid:								*!	*		*				*	**

/sa.ˈla:.m/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ ☞ a. sa. ˈla:.m																*
μ μμμ b. sa.ˈla:m			*!								*					*
μ μμ c. sa. ˈla: m											*!					*
μ μ d. ˈsa. la<m>										*!		*				*

/ma.ˈgil.t/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ ☞ a.ma.ˈgil.t															*	**
μ μμμ b. ma.ˈgilt			*!												*	**
μ μ μ c. ˈma. gi.li<t>					*!									*		*
μ μμ μ d. ˈma.gil.ti					*!									*		*

/ʤa:$_{\mu\mu}$.b$_{\mu}$.hu$_{\mu}$m	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ a. ʤa: b.hum			*!													*
μμ μ ☞ b. ʤa:b.hum																**
μμ μ c. ʤab.hum										*!		*				**
μμ μ μ d. ʤa:.bi.hum					*!									*		*

/bi$_{\mu}$n$_{\mu}$.t$_{\mu}$-ha$_{\mu}$/	ONS	*LLL	*3μ	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINEARITY	SSP	*FINAL-G	MAX-IO	*FINAL-C-μ	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ a. bint. ha			*!	*											*	**
μ μμ μ b. bi. n **i** t. ha				*!	*									*		*
μμ μ μ ☞c. bin.t**i**. ha					*									*		
μμ μ d. bint. ha				*!											*	**

The tableax (4.69) show the insights about NA syllable structure that can be gained through OT; the unified set of constraints in the tableax is the one which can analyse syllable structure in this dialect. For instance, the onsets and codas in the tableau above can be evaluated by the unified set of constraints as well as the weight of the syllables. The light and heavy CVC syllables can also be differentiated by the same framework (OT) through presenting a constraint which disfavours the moraic codas at the end of the prosodfic words: *FINAL-C-μ. Furthermore, this constraint is satified by final CVVC and CVCC syllables where the last consonant is assigned as extrasyllabic (weightless). The maximum syllable weight permitted in this dialect is bimoraic. The same constraint and *FINAL-G are used to prevent candidates with word-final geminates from being optimal. The violation of these constraints is avoided by the NA output, i.e. this shows that word-final geminates are not allowed in NA.

4.10 Summary

This chapter contained an OT analysis of Najdi syllable structure. The first section showed inputs in this study are taken from NA; some NA inputs map onto NA outputs; e.g., /χu.ˈʃu:m/ ‘noses’, /ʕi.ˈna:d/ ‘stubbornness’, /zu.ˈlu:f/ ‘sideburns’, /mu.ˈʃu:χ/ ‘scratches’, /nu.ˈʕu:l/ ‘shoes’, /ˈzaʕ.lat/ ‘she is upset’, /zi.ˈba:.lah/ ‘trash’, /ku.ˈra: ʕ/ ‘leg’, /ˈʤa:.b$_{\mu}$-hum/ ‘he brought them’, /tu.ˈʃu:f/ ‘you (m) see/she sees’, /fi.ˈlu:s/ ‘money’. Some NA inputs map onto SA outputs because these inputs are in words governed by SA phonology in the output level with reference to *Lexicon Optimization* (Yip 1996 & Kager 1999); e.g., /mu.ˈdi:r/→ [mu.ˈdi:r] ‘manager’. This behaviour is discussed in details in section 5.5.

The syllable types and their distribution in NA are demonstrated in section 4.3 in this chapter. These types are CV, CVC, CVV, CVVC, CVCC, CCV, CCVC, CCVV, CCVVC, and CCVCC. These syllables are divided into three groups; light syllables are CV and CCV. Heavy syllables are CVC, CVV, CCVC, and CCVV. Superheavy syllables are CVVC, CVCC, CCVVC, and CCVCC. In terms of the distribution of syllable types in NA, CV syllables are found initially as stressed syllables if the following syllables (final syllables) are of the form CVC; the final CVC syllable is unstressed and light because the last consonant is labelled as extrametrical. There is a restriction on the position of the CVV syllable, namely that this syllable is found in the non-final position as a heavy syllable. Similarly, superheavy syllables of the form CVVC and CVCC are restricted to certain positions: the non-final CVCC is avoided in the non-final position by vowel epenthesis, while mora sharing is used to avoid non-final superheavy syllables of the form CVVC; i.e. non-final superheavy syllables are heavy syllables followed by moraic consonants that are not affiliated to the syllables nodes (semisyllables). Syllables of the forms CCV, CCVC, CCVV, and CCVVC are found in non-final positions. The CCVCC syllable is found only in monosyllabic words; e.g., /si.ˈmint/→ [smint] ‘cement’.

The syllable inventories in languages can be attributed to the interaction of faithfulness and markedness constraints in OT. The markedness constraints including ONS, *CODA, *COMPLEX$_{ONS}$, and *COMPLEX$_{CODA}$ are universal as are MAX-IO and DEP-IO as faithfulness constraints. The ranking of these constraints is language-specific. For instance, ONS is ranked as the highest constraint in languages where onsetless syllables are not permitted. Also, the *COMPLEX$_{ONS}$ is ranked as one of higher constraints in languages where complex onsets are banned. However, ONS is not ranked as the highest constraint in languages that tolerate onsetless syllables. The *COMPLEX$_{CODA}$ constraint is ranked as one of the higher constraints in languages complex codas are not allowed. The *CODA is low-ranked in languages where syllables have codas.

There are two types of onsets in NA; simple onsets are obligatory while complex onsets are optional since some syllable types in NA exclude complex onsets. Complex onsets are created by two phonological processes, syncope and CV metathesis. The types of onsets in NA are analysed by OT.

Codas, either simple or complex, are optional in NA because some syllable types in this dialect lack codas. The difference between word-initial and word-final clusters is that word-initial clusters are created by syncope and CV metathesis, whereas complex codas are underlying because they are found in the input; this is the answer to the question regarding the source of consonant clusters in NA. The types of codas in NA are analysed by OT as well as onsets in this dialect.

Light and heavy syllables are distinguished in NA, depending on stress parameters in this dialect. For instance, the final CVC syllable is unstressed and light since the last consonant in this syllable is assigned as extrametrical; this syllable complies with extrametricality rules (Hayes 1995) discussed in subsection 2.5.1. This behaviour is accounted for within OT: the *FINAL-C-μ constraint is used to eliminate any candidates where the prosodic words end with moraic codas. According to the stress parameter in (VII) in the same section, there is a restriction on the position of the CVG syllable in disyllabic words. Consequently, the word-final geminate is the target of degemination and the last consonant is assigned as extrametrical. The stress is received by the preceding syllable (regression of stress); e.g., /ji.ˈmidd/→ degmination→ [ˈji.mid] ‘he spreads’. This behaviour is accounted for within OT: the *FINAL-G constraint militates against word-final geminates and the *3μ is violated by candidates with tri-moraic syllables.

There are different treatments of superheavy syllables of the forms CVVC and CVCC in NA; non-final superheavy syllables are heavy syllables of the form CVV and CVC which are followed by semisyllables. Non-final CVCC syllables that are associated with consonant-initial suffixes are avoided by vowel epenthesis while non-final superheavy syllables CVVC that are associated with consonant-initial suffixes are avoided by mora sharing rather than vowel epenthesis: i.e., a semisyllable shares a mora with the second member of a long vowel in the non-final syllable. These syllables are accounted for using OT. The SYLLCON constraint is against rising sonority across the syllable boundary and the *3μ constraint eliminates candidates with tri-moraic syllables. The final stressed CVVC and CVCC syllables are considered to be heavy since their last consonants are assigned as extrasyllabic. In other words, the last consonant (peripheral) in these syllables is weightless in order to satisfy the *FINAL-C-μ constraint.

In section 4.9, the unified set of constraints was presented after demonstrating the weight of the syllable and superheavy syllables in NA in order to address the question of what insights about NA syllable structure can be gained through OT. This set is shown to be capable of analysing the syllable structure in this dialect.

The question related to the source of initial bi-consonantal clusters in NA has been answered. The first half of the question regarding the insights about NA syllable structure that can be gained through OT has been answered in this chapter. The second half of the same question will be addressed in the next chapter. In other words, in the next chapter, I will answer the question regarding the insights about related processes in NA that can be gained through OT. Furthermore, there are other questions that will be addressed in the same chapter: how are non-final superheavy syllables of the forms CVVC and CVCC avoided in NA? To what extent are sonority violations tolerated in some final consonant clusters in NA? What are the motivating factors for vowel shortening in NA?

Chapter 5. Syllable Structure Processes in NA

5.1 Introduction

The aim of this chapter is to analyse some processes that are closely related to syllable structure. There are seven illustrated sections after the section of introduction. Section 5.2 will examine how metathesis, which is associated with guttural resyllabification, affects NA syllable structure. Section 5.3 will deal with epenthesis and its motivators; this section will address the question of how the SSP violations are tolerated in final consonant clusters in this dialect along with the question of how non-final superheavy syllables are avoided in NA. The question of the motivating factors for vowel shortening in NA will be addressed in section 5.4. The following section (5.5) will be devoted to demonstrating syncope and its motivating factors in this dialect. The question of syllable structure processes that can be gained through OT will be addressed in section 5.6 where there is a unified set of constraints used to account for metathesis, epenthesis, vowel shortening, and syncope. In section 5.7, there will be a comparison between NA and UHA regarding CV-meathesis, vowel epenthesis, and syncope in light of OT. The summary of conclusion of this chapter will be in section 5.8.

5.2 Metathesis

As shown in subsection 4.2.1, Metathesis and syncope create initial consonant clusters in NA. These have not yet been accounted for using OT, and therefore in this section I will demonstrate the types of metathesis and the origins of these types. Also, I will show how metathesis has an impact on the syllable structure in NA, and present an analysis using OT.

Blevins & Garrett (1998:523) state that CV metathesis in NA results from a two-step diachronic process of pseudometathesis; epenthesis plus deletion or vice versa. Psuedometathesis is defined as “a process of vowel epenthesis followed historically by vowel deletion, or vice versa” (Blevins and Garrett 1998:540). They state that the difference between both metathesis types is that CV metathesis is synchronic in nature, whereas psuedometathesis is diachronic. To demonstrate this, Blevins and Garrett (1998) propose that some words in NA undergo the diachronic process of epenthesis followed by deletion, and that this behaviour is found in pseudometathesis:

(5.1)

Pseudometathesis in NA

	Epenthesis	Deletion	Gloss
/gah.wa/	ga.ha.wa	gha.wa	‘coffee’
/naχ.lah/	na.χa.lah	nχa.lah	‘palm tree’

In fact, this type of metathesis in NA is derived from Negev Bedouin Arabic because NA was historically similar to Negev Bedouin Arabic (Blanc 1970; Blevins & Garrett 1998: 523).[40] However, the stem and epenthetic vowel are still preserved in Negev Bedouin Arabic, whereas the stem vowel was targeted by deletion and a copy vowel remained in NA. This type of metathesis no longer exists in NA while CV meathesis, as a synchronic process, is still produced by NA native speakers through swapping a guttural and a preceding vowel without vowel epenthesis and syncope. Consider the following table:

(5.2)

a) Metathesis in NA: VC→CV

Unmetathesized Input	Metathesized Output	Gloss
/m**<u>aħ</u>**.buus/	m**<u>ħa</u>**.buus	‘imprisoned’
/n**<u>aʕ</u>**.dʒat/	n**<u>ʕa</u>**.dʒat	‘ewe’

The main focus will be on CV metathesis. The data on CV Metathesis in NA has been reported by scholars including Abboud (1979), Ingham (1994), Zawaydeh (1999), and Al-Solami (2013) (see section 3.5). They unanimously agree that initial consonant clusters result from metathesis. This view is supported by examples in (5.3) below:

(5.3) CV Metathesis in NA

a) /g**<u>ah</u>**.wa/→ [g**<u>ha</u>**.wa] ‘coffee’

b) /n**<u>aχ</u>**.lah/ → [n**<u>χa</u>**.lah] ‘palm tree’

[40] As discussed in section 3.4, Zawaydeh (1999) reports that some dialects cannot tolerate gutturals in final syllables like NA and Negev Bedouin Arabic. As a result, in Negev Bedouin Arabic, a vowel is inserted after a guttural to avoid this consonant being in the coda position. According to Blanc (1970), Blevins & Garrett (1998), the same behaviour is found in NA since this dialect was historically similar to Negev Bedouin Arabic. In other words, gutturals in coda position were initially avoided by vowel epenthesis in NA as well as in Negev Bedouin Arabic. Then, at a later stage, an underlying vowel underwent deletion, and the epenthetic vowel was retained.

c) /n**aħ**.lim/ → [n**ħa**.lim]. ‘we dream’

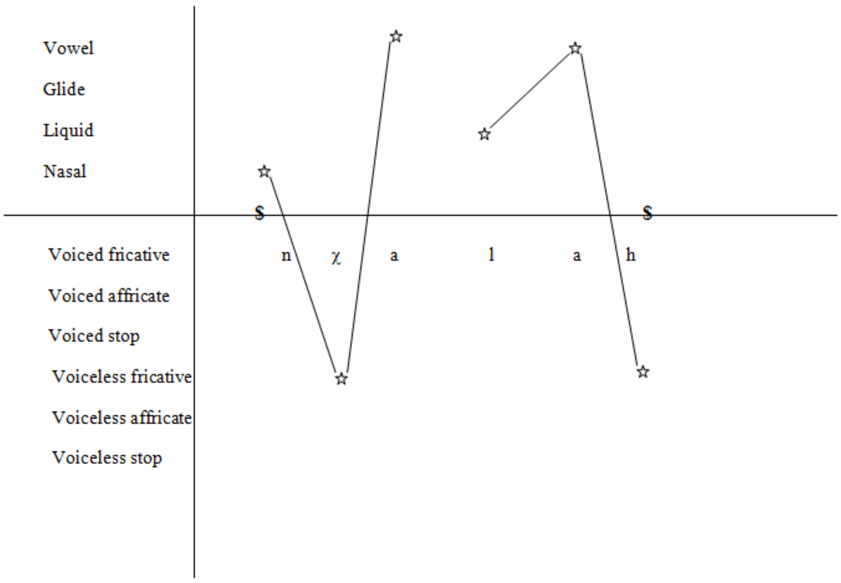
d) /t**aʁ**.ris/→[t**ʁa**.ris] ‘she plants’

e /j**aʁ**.ris/→[j**ʁa**ris] ‘he plants’

f) /s**aʔ**.lat/→[s**ʔa**.lat] ‘she asked’

As illustrated in the examples in (5.3) above, initial bi-consonantal clusters are created through Guttural Resyllabification (metathesis); i.e. metathesis involving one of the guttural consonants, discussed in section 4.4. As a result, as mentioned in (4.4), some consonant clusters created by Guttural Resyllabification (metathesis) above violate the SSP e.g. /gh-/, /nχ-/, /nħ-/, and /jʁ-/, whereas consonant clusters like /tʁ-/, accord with the SSP (3.13) in section 2.4. Consider the following representation of the output [n**χa**.lah] ‘palm tree’:

(5.4) [n**χa**.lah] ‘palm tree’



With respect to Abboud (1979), Ingham (1994), Zawaydeh (1999), and Al-Solami (2013), this process has not been accounted for using OT. For this reason, in the next tableau, I will use the universal markedness and faithfulness constraints ONS, MAX-IO, MAX-μ-IO, DEP-IO, $*\text{COMPLEX}_{\text{ONS}}$, $*\text{COMPLEX}_{\text{CODA}}$, and $*\text{COMPLEX}_{\text{CODA}}$. Furthermore, I will add another constraint which militates against metathesis: LINEARITY.

Likewise, the SYLLCON constraint against rising sonority across a syllable boundary will be added to the tableau (5.5). Consider the following constraints:

(5.5) LINEARITY

S_1 reflects the precedence structure of S_2, and vice versa.

(Pater 1995:6)

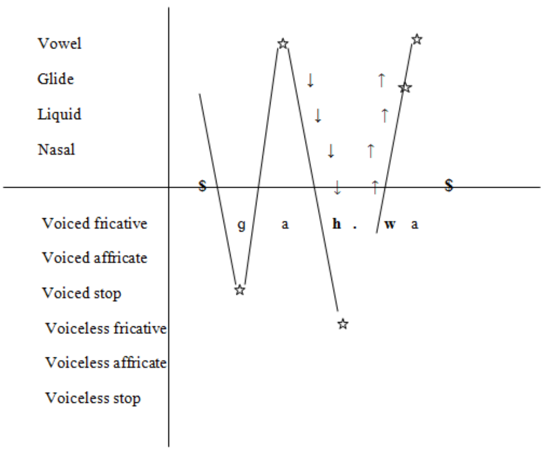
The constraint in (5.5) will be added to a set of ranking constraints that includes ONS, MAX-IO, DEP-IO, $\text{COMPLEX}_{\text{ONS}}$, and *CODA in order to eliminate any candidate output that has an initial consonant cluster resulting from metathesis. In the tableau below, I evaluate the candidate analyses of the input /gahwa/ in order to optimise an output /gha.wa/ from NA:

(5.6) ONS>> LINEARITY>>MAX-IO>> MAX-μ-IO >>*$\text{COMPLEX}_{\text{ONS}}$>>DEP-IO>>*$\text{COMPLEX}_{\text{CODA}}$ >>*CODA

/gah.wa/	ONS	LINERITY	MAX-IO	MAX-μ-IO	*$\text{COMPLEX}_{\text{ONS}}$	DEP-IO	*$\text{COMPLEX}_{\text{CODA}}$	*CODA
☹ a. gah.wa								*
b. gha.wa		*!			*			
c. ga.h**a**.wa						*!		

The tableau above shows candidate (a) as the optimal output because it has no violation of highly-ranked constraints, whereas candidate (b), as a desired output, does not become optimal due to the violation of LINEARITY as a highly-ranked constraint. Candidate (c) fails to avoid the violation of DEP-IO constraint. Looking at candidate (a), it is clear there is rising sonority across a syllable boundary as shown in the representation of this candidate below:

(5.7) The representation of [gah.wa]



According to the representation (5.7), rising sonority across a syllable boundary is achieved by the coda of the non-final syllable [h], as a voiceless fricative, and the onset of the following syllable [w], as a glide. A voiceless fricative [h] in this output is less sonorous than a glide [w]. In fact, Bat El (1996:302) introduces a constraint that disfavours rising sonority across a syllable boundary as follows:

(5.8) Syllable Contact (SYLLCON)[41] Bat El (1996:302)
The onset of a syllable must be less sonorous than the last segment in the immediately preceding syllable, and the greater the slope in sonority the better.

The constraint in (5.8) will be ranked higher than LINEARITY and *COMPLEX$_{ONS}$ constraints in order to eliminate candidate [gah.wa] from being optimal. Consider the following tableau:

(5.9)

ONS>> LINEARITY>>MAX-IO>>*COMPLEX$_{ONS}$>>DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

/gah.wa/	ONS	SYLLCON	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. gah.wa		*!							*
b. gha.wa			*!			*			
☹ c. ga.h**a**.wa							*		

[41] Bat El (1996) proposed this constraint based on the Syllable Contact Law introduced by Vennemann (1988).

Although the SYLLCON constraint helps to prevent candidate (a) from being optimal, the desired output (b) is determined as optimal due to the violation of the LINEARITY constraint. Candidate (c) avoids the violation of the SYLLCON constraint by inserting a vowel after a glide which results in a sequence of three light syllables. This candidate becomes optimal. In order to eliminate candidate (c) from being optimal, I introduce the following constraint that militates against a sequence of three light syllables.

(5.10) *LLL:

Assign one violation mark for three light syllables.

The constraint in (5.10) will be outranked the LINEARITY and SYLLCON in order to help determining the desired output [gha.wa] as optimal:

(5.11)

ONS>>*LLL>>SYLLCON>>LINEARITY>>MAX-IO>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP-IO>>*COMPLEX$_{CODA}$ >>*CODA

/gahwa/	ONS	*LLL	SYLLCON	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. gah.wa			*!							*
☞ b. gha.wa				*			*			
c. ga.h**a**.wa		*!						*		

The output (b) which is correct for NA is distinguished as an optimal candidate analysis because it satisfies the constraints*LLL and SYLLCON, whereas the output (a) is not optimal due to the violation of SYLLCON as a highly-ranked constraint. Also, light antepenultimate and penultimate syllables in output (c) result in the violation of the *LLL constraint. What if we have [gaw.wa] as a candidate that competes against other candidates? Is it possible to determine the desire output [gha.wa] as an optimal candidate? To find out, let us consider the following tableau:

(5.12)

ONS>>*LLL>>SYLLCON>>LINEARITY>>MAX-IO>> MAX-μ-IO >>*COMPLEX$_{ONS}$>>*COMPLEX$_{CODA}$>>DEP-IO>>*CODA

/gahwa/	ONS	*LLL	SYLLCON	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. gah.wa			*!							*
b. gha.wa				*!			*			
c. ga.h**a**.wa		*!						*		
☹ d. gaw.wa										*

Candidate (d) becomes optimal since it avoids the violation of *LLL, SYLLCON, and LINEARITY constraints. Candidate (a) cannot be optimal due to the violation of the SYLLCON constraint. Candidate (c) is eliminated from being optimal due to the violation of the *LLL constraint. Candidate (b), as the desired output, fails to be optimal because it violates the LINEARITY constraint. To solve this problem, I introduce the following constraint that can eliminate candidate (d):

(5.13) *LENITION-GUTTRAL

The manner of articulation of gutturals should not be changed to a vowel-like (more sonorous) one.

The constraint in (5.13) will be ranked higher than LINEARITY in order to determine the output [gha.wa] as optimal. Consider the following tableau:

(5.14)

ONS>>*LLL>>SYLLCON>>*LENITION-GUTTURAL>>LINEARITY>>MAX-IO>> MAX-μ-IO >> *COMPLEX$_{ONS}$ >> *COMPLEX$_{CODA}$ >> DEP-IO>>*CODA

/ˈgah.wa/	ONS	*LLL	SYLLCON	*LENITION-GUTTRAL	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈgah.wa			*!								*
☞b. ˈgha.wa					*			*			
c. ˈga.h**a**.wa		*!							*		
d. ˈgaw.wa				*!							*

The *LENITION-GUTTURAL constraint helps eliminate candidate (d) from being optimal; the guttural in the coda position of the non-final syllable is changed to glide [w] which is more sonorous than a voiceless fricative [h]. Candidate (a) avoids the violation of the *LLL constraint by blocking vowel epenthesis after a guttural [h] but this blockage results in the violation of the SYLLCON constraint. Candidate (c) permits vowel epenthesis after a guttural [h] in order to comply with the SYLLCON constraint but this vowel epenthesis leads to the violation of the *LLL constraint. As a result, candidate (b) is identified as optimal. The same constraint ranking will be used to evaluate the candidate analysis of the input /naχ.lah/ ‘a plam tree’. Consider the following tableau:

(5.15) /naχ.lah/→ [nχa.lah]

ONS>>*LLL>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >>*COMPLEX$_{CODA}$ >> DEP-IO>>*CODA

/ˈnaχ.lah/	ONS	*LLL	SYLLCON	*LENITION-GUTTURAL	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈnaχ.lah			*!								**
☞b. ˈnχa.lah					*			*			*
c. ˈna.χ**a**.lah		*!							*		*
d. ˈnal.lah				*!							

The ranked set of constraints above identifies output (b) as an optimal candidate since this output satisfies the *LLL, SYLLCON, and *LENITION-GUTTERAL constraint. Output (a) is eliminated from being optimal by the violation of SYLLCON; hence, a coda in the non-final syllable, as a voiceless fricative, is less sonorous than an onset of the following syllable, as a liquid. As a result, there is rising sonority across the syllable boundary. Output (c) avoids the violation of SYLLCON through vowel epenthesis after a guttural /χ/. However, a sequence of three light syllables results in violating the *LLL constraint. Output (d) satisfies the *LLL and SYLLCON constraints but fails to avoid the violation of the *LENITION constraint. Consequently, output (b) is selected to be optimal.

In conclusion, the impact of metathesis (Guttural Resyllabification) on syllable structure in NA was reviewed in this section. It also demonstrated how metathesis creates initial bi-consonantal clusters that violate the SSP, such as /gh-/, /nχ-/, /nħ-/, /jʁ-/, and consonant clusters that conform to the SSP like /tʁ-/ according to the sonority scale introduced by Parker (2008) (see section 2.4). This phonological process was accounted for using OT, as an analytical framework. Metathesis in NA is mostly used to avoid rising sonority across a syllable boundary. Therefore, I referred to SYLLCON militates against rising sonority across a syllable boundary. Also, the *LLL constraint is employed to prevent any candidate with a sequence of three light syllables from being selected as optimal and the *LENTION-GUTTURAL constraint is used to eliminate any candidate where the lenition of gutturals occur. In the next section, I will clarify how epenthesis affects NA syllable structure and account for this phonological process using OT.

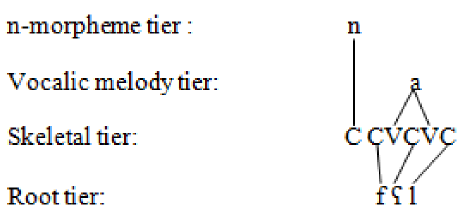
5.3 Epenthesis

5.3.1 Initial Epenthesis (Prosthesis) in NA

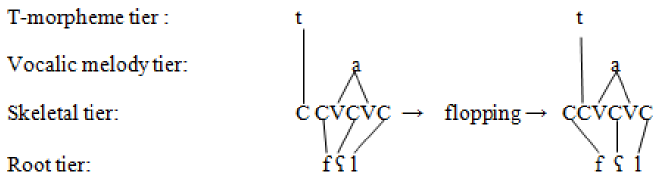
This is an interaction between morphology and phonology regarding binyan forms in Arabic; the affixal roots /-t-/ and /n-/ are attached to the triliteral verb of the form I, /faʕal/, while the affixal /st-/ are attached to the form IV, /ʔafʕal/, resulting in the deletion of an initial glottal stop, i.e. st-ʔafʕal→ the deletion of a glottal stop→ stafʕal. In the eighth form /XIII/, the prefix /t-/ becomes infix, /-t-/, through the flopping rule (metathesis) that is introduced by McCarthy (1981), i.e. t-faʕal → flopping→ftaʕal. Consider the following representations.

(5.16)

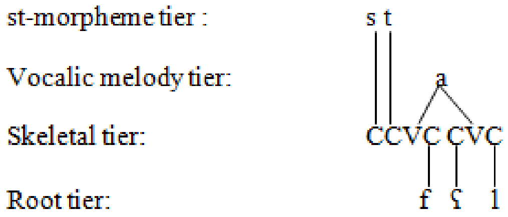
a. The form VII /nfaʕal/



b. The verb form VIII /ftaʕal/



c. The form X /stafʕal/



The sequences of two consonants in the verb forms in (5.16) motivate initial epenthesis, according to Abboud (1979) and Al-Mohanna (1998) (see subsection 3.2.2). In (5.17), the sequences of two consonants in the binyans (VII), (VIII), and (X) in NA precede prosthesis as follows:

(5.17)	Binyan	perfect active	Example	Translation
	VII	/nkatab/	[**ʔi**n.ka.tab]	‘got written’
	VIII	/kti ʃaf /	[**ʔi**k.ti.ʃaf]	‘he discovered’
	X	/staktab/	[**ʔi**s.tak.tab]	‘caused to write’

As shown in (5.17), it is clear that the binyan forms, VII, VIII, and X, motivate initial epenthesis (prosthesis). The following constraint will be used to eliminate any candidate with a sequence of voiceless plosives in the initial position:

(5.18)

*[VOCELESS PLOSIVES *[VP

A sequence of voiceless plosives in the initial position assigns one violation mark.

This constraint will be outranked by SYLLCON in the following tableau in order to determine the output [**ʔi**k.ti.ʃaf] of the input /kti.ʃaf / ‘he discovered’:

(5.19)

ONS>>*LLL>>*[VP>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈkti.ʃaf/	ONS	*LLL	*[VP	SYLLCON	*LENITION-GUTTURAL	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈkti.ʃaf			*!						*			**
☞ b. ˈʔik.ti.ʃaf										**		*
c. ˈki.ti.ʃaf		*!								*		*
d. ˈik.ti.ʃaf	*!									*		

The tableau (5.19) shows that output (b) is chosen as the optimal candidate analysis of the input /kti.ʃaf/ ‘he discovered’. Output (d) lacks an onset which results in violating the ONS constraint. Output (c) avoids the violation of the *COMPLEX$_{ONS}$ constraint by internal vowel epenthesis but it fails to satisfy the *LLL constraint. Output (a) cannot be optimal due to the violation of the *[VP constraint.

As discussed in section (3.2.2), Abboud (1979) notes that initial epenthesis (prosthesis) is found in some imperative forms; e.g., /skin/→ [**ʔi**skin] ‘dwell! (m.s.)’, /gtˤaʕ/→ [**ʔi**gtˤaʕ] ‘cut! (m.s.)’, and /hʤim/→ [**ʔi**hʤim] ‘attack! (m.s.)’. Rakhieh (2009) observes that the same behaviour is also found in Ma’ani (see subsection 3.2.2). In the next tableau, I will evaluate the candidate analysis of the input /skin/ ‘dwell!’ in NA using the same set of constraints in (5.20):

(5.20)

ONS>>*LLL>>*[VP>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> DEP-IO >>*COMPLEX$_{CODA}$ >>*CODA

/ˈskin/	ONS	*LLL	*[VP	SYLLCON	*LENITION-GUTTURAL	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈskin									*!			*
b. ˈ**<u>ʔi</u>**s.kin										**!		**
☹ c. ˈs<u>**i**</u>.kin										*		*
d. ˈ<u>**i**</u>s.kin	*!									*		**

Candidate (a) cannot be optimal since it violates the *COMPLEX$_{ONS}$ constraint while the violation of the same constraint is avoided by initial vowel epenthesis in candidate (d). However, this epenthesis results in an onsetless syllable in the same candidate which violated the ONS constraint. The *COMPLEX$_{ONS}$ and ONS constraints are satisfied by candidate (d), as a desired output; the violation of the *COMPLEX$_{ONS}$ is avoided by initial vowel epenthesis and the insertion of a glottal stop is to comply with the ONS constraint. The two insertions of a vowel and a glottal stop result in two violation marks of the DEP-IO constraint. As a result, this candidate fails to be optimal, whereas the internal epenthesis in candidate (c) results in one violation mark of the same constraint (DEP-IO) and this candidate becomes optimal. To determine candidate (b) as optimal, it is important to shed light on the difference between candidates (c) and (b); candidate (c) includes internal epenthesis, whereas candidate (b) includes prosthesis (initial epenthesis). Accordingly, there should be a constraint that disfavours any candidate with internal epenthesis in order to eliminate candidate (c) from being optimal. In other words, we seek a constraint that helps the desired output (b) to be selected as optimal. This behaviour is demonstrated by McCarthy&Prince (1993), Kenstowicz (1994b), Spencer (1994) and Al-Mohanna (1998). In fact, as mentioned in subsection 3.2.2, the internal insertion in this case has been rejected by McCarthy&Prince (1993), Kenstowicz (1994b), and Spencer (1994) (see subsection 3.2.2). Yet, as also noted in subsection 3.2.2, McCarthy and Prince (1993:50) declare that an appropriate constraint that enforces contiguity is recommended if there is a cross-linguistic bias against internal epenthesis in a case in which there is a choice between medial and peripheral epenthesis. Therefore, in this case, McCarthy and Prince (1995:108) introduce the O-CONTIG constraint which does not permit internal epenthesis. This constraint should be ranked higher than DEP-IO in order to prevent output (c) from being distinguished as optimal. Consider the following tableau:

(5.21)

ONS>>*LLL>>*[VP>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >> DEP-IO >>*COMPLEX$_{CODA}$>>*CODA

/skin/	ONS	*LLL	*[VP	SYLLCON	*LENITION-GUTTURAL	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈskin									*!				*
☞ b.ˈ**ʔi**s.kin											**		**
c. ˈs**i**.kin										*!	*		*
d. ˈ**i**s.kin	*!										*		**

The tableau above identifies output (b) as the optimal candidate since it satisfies most of the constraints, especially the O-CONTIG constraint that is violated by output (c). Output (a) is immune to phonological processes like deletion and epenthesis, but it cannot escape the violation of *COMPLEX$_{ONS}$. The same constraint and O-CONTIG are satisfied by output (d) through initial-vowel epenthesis but this insertion results in an onsetless syllable in this candidate which violates the ONS constraint.

Initial epenthesis is applied to initial geminates in NA since this type of geminate is disallowed in most modern Arabic dialects, except Moroccan Arabic, according to Kiparsky (2003) and Watson (2007), and Boudlal (2001) (see subsection 3.2.2 and section 3.4).[42] This view is shown in the examples in (5.22) below:

(5.22)

a. /ti+daris/→/t.daris/→/ddaris/→ [ʔid.daris] 'you (m.s.) teach'

b. /ti+zahib/→/tzahib/→ /zzahib/→ [**ʔi**z.za.hib] 'you (m.s.) prepare'

[42] Initial geminates result from two processes; the first process is particular to the deletion of a vowel in the prefix in order to permit assimilation of a prefix to an onset as the second process. The reason for this assimilation is to avoid the violation of OCP (Obligatory Contour Principle) with reference to Libyan Arabic dialects (Harrama 1993, and Elramli 2012).

The initial geminate as a motivator for prosthesis will be accounted for using OT. In the next tableau, the candidate analyses of the input /ˈti.da.ris/ will be evaluated with the same set of constraints in (5.21):

(5.23)

ONS>>*LLL>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>> MAX-IO>> MAX-μ-IO>>*COMPLEX$_{ONS}$>> O-CONTIG>>DEP-IO>> *COMPLEX$_{CODA}$>>*CODA

/ˈti.da.ris/	ONS	*LLL	*[VP	SYLLCON	*LENITION-GUTTURAL	LINERITY	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈtda.ris							*	*	*!				*
b. ˈdda.ris							*	*	*!				**
☞c. ˈʔid.da.ris							*	*			**		*
d. ˈti.da.ris		*!											**

The tableau above distinguishes output (c) as the optimal candidate because it avoids the violation of the *COMPLEX$_{ONS}$ constraint, whereas outputs (a) and (b) cannot be optimal because they equally violate the same constraint. Output (d) fails to be optimal due to the violation of the *LLL constraint, even though this candidate is mostly faithful to the input.

To conclude, this subsection illustrates how the triliteral verbs of the forms (VII), (VIII), and (X) motivate prosthesis with reference to NA. Some imperative forms in NA have initial epenthesis rather than internal epenthesis, and this behaviour was accounted for in this subsection within OT. This third motivator of initial epenthesis (prosthesis) relates to initial geminates which are not permitted in most modern Arabic dialects, as demonstrated in subsection 3.2.2 and section 3.4. OT was shown to account for this motivator as well as the previous motivators for initial epenthesis. Internal epenthesis will be demonstrated in the next subsection.

5.3.2 Internal Epenthesis in NA

5.3.2.1 Sonority and epenthesis

The violation of the Sonority Sequencing Generalization in the coda cluster of the superheavy syllable CVCC is considered one of the motivations of epenthesis in some

Arabic dialects in general and in NA in particular, according to Ingham (1994), who states that epenthetic vowels occur between the last two consonants and create a new syllable in NA.[43] It is clear that the two syllables, CV.C**v**C, are the result of the occurrence of an epenthetic vowel which functionally breaks the complex cluster that violates sonority sequencing in the coda. These two syllables exhibit the restriction of sonority imposed on the syllable. Why does sonority violation (Reverse Sonority) in the word-final clusters motivates vowel epenthesis but the same does not hold in word-initial clusters in NA which show no epenthesis? As discussed in section 4.5, word-initial clusters in NA result from CV-metathesis and syncope; some of these clusters obey the SSP like /tr-/, /gr-/, /zl-/, and so on, while other word-initial clusters including /rf-/, /nχ-/, /gh-/, and so on do not comply with the SSP; i.e. these clusters constitute Reverse Sonority. Word-initial clusters that violate the SSP do not motivate vowel epenthesis, unlike word-final clusters that constitute Reverse Sonority. This argument is supported by Khan (1976:26) and Al-Mozainy (1981:210) who state that the violation of the syllabic constraint is allowed when dealing with derived forms rather than basic forms. In other words, the word-initial clusters' violation of the SSP in NA is tolerated because these consonant clusters are created by syncope as well as CV metathesis; i.e. they are derived not lexical. Reverse Sonority that results from the word-final cluster in the underlying form /CVCC/ motivates vowel epenthesis. It is also observed in NA that Plateau Sonority, as one of the manners of the SSP violation, does not motivate vowel epenthesis. Accordingly, this subsection is assigned to show how Reverse Sonority in the word-final clusters in the underlying forms motivates internal epenthesis.

5.3.2.1.1 Sonority and the Syllable

In subsection 3.2.1, I described sonority and its relation with syllable structure cross-linguistically: Clements (1990) introduces the SSP (Sonority Sequencing Principle) which is based on ascending the sonority upwards to a peak (vowel) and descending towards syllable boundaries (codas). In the onset, sonority ascends towards onsets if there is one consonant following a vowel and vice versa in codas. In terms of complex clusters, the situation is that in any initial cluster, the second member must be more

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[43] Ingham (1994) mentions the cases in which epenthetic vowels occur; hence, one of the cases regarding words that have final clusters and the second members of these clusters are r, l, w, y, and n (voiced continuants). According to the examples that he presents in his book, I observed that epenthetic vowels occur in final clusters that include these voiced continuants and which therefore violate the Sonority Sequencing Principle. For example, one of the words he mentions is $mas^{ʕ}$**u**r 'Egypt' in which the final cluster prior to epenthesis violates the Sonority Sequencing Principle due to the final voiced continuant liquid /r/ being more sonorous than the continuant voiceless obstruent /$s^{ʕ}$/.

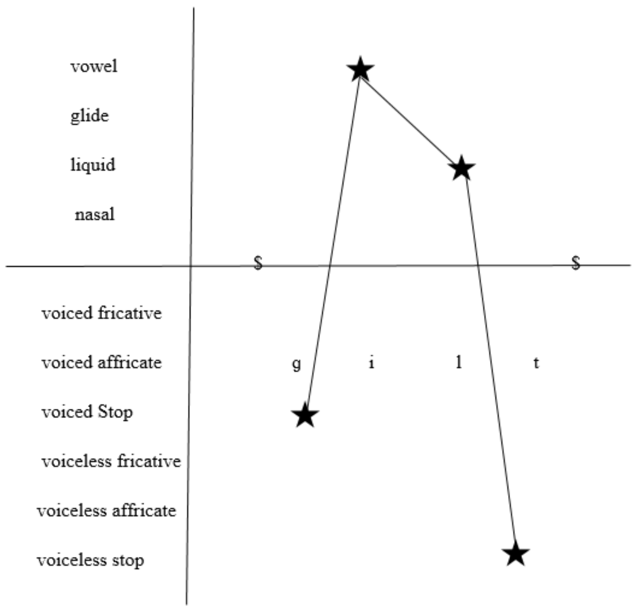
sonorous than the first one. For this reason, sonority can ascend upwards to a peak (vowel), whereas, in any final cluster, sonority goes the other way around by having a second member of this cluster being less sonorous than the first one; therefore, sonority here descends towards the syllable boundaries.

In order to understand the sonority of vowels and consonants, as mentioned in subsection 1.3.1, Parker (2008) presents a sonority scale of consonants and vowels in which vowels are the most-highly sonorous, whereas stops are the least sonorous.

Hereafter, glides are considered to be the second highest in sonority after vowels, compared to liquids, while voiced obstruents are more sonorous than voiceless ones. Thus, in Parker's (2008) sonority scale of obstruents, as demonstrated in section 2.4, voiced fricatives are more sonorous than voiced affricates, and plosives of which voiced plosives are more sonorous than voiceless fricatives, affricates, and plosives.

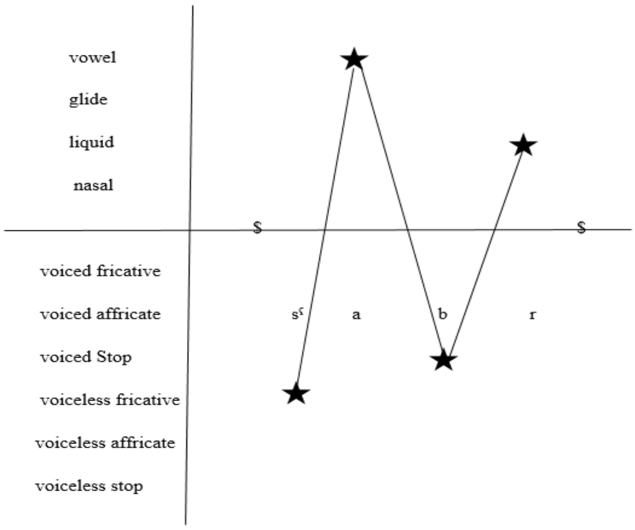
In this subsection, the main purpose is to investigate what the relation is between the SSG (Sonority Sequencing Generalization) and syllable structure in NA. In fact, there is a concrete example taken from this dialect in particular that shows how the SSP (Sonority Sequencing Principle) functions: the Arabic word [gilt] 'I said'. Consider the following representation in (5.24) below:

(5.24)



This syllable is obviously following the SSP which means that this syllable has one peak preceded by smoothly descending sonority values towards the syllable boundaries. As we can see here, from an obstruent onset segment /g/, the sonority starts ascending upwards to the peak which is occupied by a vowel. After the peak, the sonority descends towards the other syllable boundary because the first consonant, as a liquid, in the coda, according to the sonority scale, is more sonorous than the second consonant, as an oral stop, which is closer to the syllable margin. However, this is unfortunately not the case for all syllables, in that some syllables are ill-behaved due to their violation of SSP. For example, the output [sˤabur] ‘patience’ in NA conforms to the SSP since the last consonant cluster that violates the SSP is broken up by the epenthetic vowel [u]. The representation of the word ‘sˤabr’ ‘patience’ in which the last consonant cluster violates the SSP is shown in (5.25) below:

(5.25)

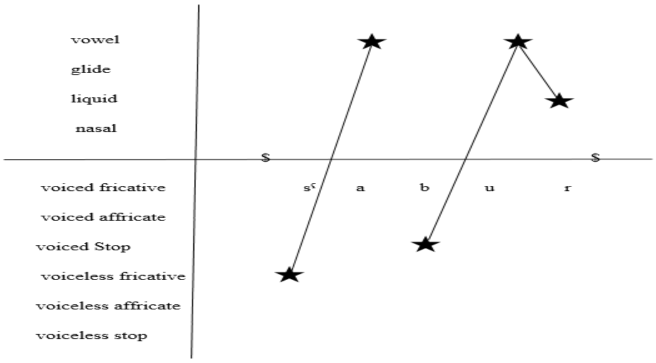


According to the representation above, without epenthesis, there would be a violation of SSP because a peripheral consonant /r/, as a second member in the final consonant cluster, is more sonorous than /b/ as a first member. As a result, the curve is not consistently as it is supposed to be, therefore, a sonority trough is created at /b/.

In some Arabic dialects, including NA, vowels are inserted between coda consonants in order to solve such violations of the SSP. Consequently, the new sonority will curve consistently. It is clear that vowel epenthesis is motivated by the internal structure of the syllable and it results in having two syllables instead of one. From these changes, we can possibly understand how the structure of the syllable is being affected by epenthesis.

In order to see this process in action graphically, let us consider the following representation:

(5.26)



From this representation, we can see how the violation of the SSP is solved by epenthesis in a word such as ‘sˤabr’ (patience); i.e., /sˤabr/ → [sˤab**u**r]. Also, as we can see, this creates a new sonority profile which starts from the first consonant in the coda /b/ and curves consistently, unlike the previous representation (5.25). This process reveals the relation between the SSP and syllable structure in NA. In example (5.26), it is clear that a final consonant cluster that violates the SSP is broken up by an epenthetic vowel /u/. Also, the syllable structure of the same example is changed from a monosyllabic structure to a disyllabic structure due to vowel epenthesis. This behaviour will be accounted for using OT in 5.3.2.1.2.

5.3.2.1.2 Constraints of Sonority

It is clear that not all syllable types of NA can potentially violate the SSP due to the fact that there are four syllable types out of nine which have no consonant clusters: these syllables are CV, CVC, CVV, and CVVC, which clearly show how sonority curves consistently. However, there are another five syllable types which appear to be problematic, as they have more than one consonant in onset, coda, or both positions. These syllables are CVCC, CCV, CCVV, CCVC, CCVVC and CCVCC. The case here is that the consonant clusters that these syllable types have in the coda position may violate the SSP by having the consonant closer to the syllable boundary more sonorous than the one closer to the peak. The potential violation of the SSP in coda position motivates vowel epenthesis rather than in the onset of some modern Arabic dialects, including NA. Therefore, I concentrate on the violation of the SSP in the coda position. This claim, in fact, follows works of scholars including Abdul-Karim (1980), Jarrah

(1993), Al-Mohanna (1998), Gouskova & Hall (2009), Rakhieh (2009), and Ibrahim (2012) (see subsection 3.2.1).[44] Al-Mohanna (1998) claims that this phenomenon can be experienced only with the syllable type CVCC with reference to UHA (Urban Hijazi Arabic). In other words, as mentioned in the subsection 3.2.1, he believes that CVCC does not violate SSP because the consonant cluster in the coda is always occupied by a geminate, whereas the loanword /fa:ks/ 'fax', for example, which represents the canonical shape CVVCC is considered the exceptional case in which the consonant cluster in the coda position violates SSP. Unlike Al-Mohanna's (1998) finding, Clements (1990) and Carlisle (2001) identify two types of SSP violation: e.g. Plateau Sonority results from the members of consonant clusters that are equally low in sonority.[45]Sonority reverse involves cases where sonority descends initially and ascends finally. McCarthy (1986) and Rakhieh (2009) support the idea that a geminate does not violate the SSP since it represents a single unit; a geminate is not a cluster. According to this view, it is clear that the final consonant cluster which is occupied by a geminate does not violate the SSP, compared to clusters with two members that are not identical but are equally sonorous. Therefore, the sonority in this case does not fall towards a syllable margin as it should do. As discussed above, this dialect permits the occurrence of vowel epenthesis in order to create a new SSP-violation-free syllable. In fact, there are some monosyllabic nouns of the form CVCC in NA which surface as disyllabic nouns because epenthetic vowels are inserted between the members of final consonant clusters, CVCC → CV.C<u>**v**</u>C. Consider the following examples below:

(5.27)	a. /ħibr/	→	ħib<u>**i**</u>r	'ink'
	b. /dʒism/	→	dʒis<u>**i**</u>m	'part'
	c. / ħukm/	→	ħuk<u>**u**</u>m	'verdict'
	d. /sukr/	→	suk<u>**u**</u>r	'intoxication'
	e. /faħm/	→	faħ<u>**a**</u>m	'coal'

[44] Al-Mozainy (1981) indicates that BHA (Bedouin Hijazi Arabic) cannot tolerate the violation of the SSP in the coda position, especially when a peripheral consonant is more sonorous than the one closer to a nucleus (Reverse Sonority). As a result, vowel epenthesis is permitted as an ad hoc solution to solve this problem. The reason for mentioning BHA is because it behaves as NA does in terms of dealing with reverse violation in coda position.

[45] Blevins (1996) found that languages that permit both initial and final geminates can tolerate Sonority Plateaus. This means that geminates violate the SSP, because they represent the Sonority Plateaus, as one of the manners of SSP violations, according to both Clements (1990) and Carlisle (2001).

f. /baħr/ → baħ**a**r ‘sea’

g. / ħabl/ → ħab**i**l ‘rope’

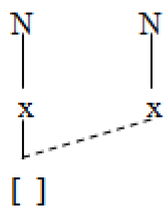
h. /ʔakl/ → ʔak**i**l ‘eating’

i. /fadʒr/ → fadʒ**u**r ‘dawn’

j. /sˤabr/ → sˤab**u**r ‘patience

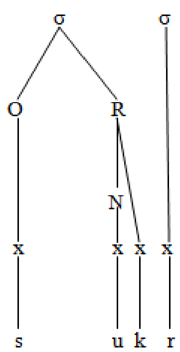
It is clear that vowel epenthesis is inserted between the last two consonants in all forms in (5.27) to avoid violation of the SSP. The quality of epenthetic vowels above is different. For instance, the epenthetic vowels [i] and [u] are determined by the stem vowels /i/ and /u/. In other words, the vowel melody spread rules introduced by Jarrah (1993) in subsection 3.2.1, are adopted in this section in order to illuminate how the epenthetic vowels [i] and [u] undergo progressive harmony from the stem vowels /i/ and /u/ in NA as shown in (5.28):

(5.28) Vowel Melody Spread Rule



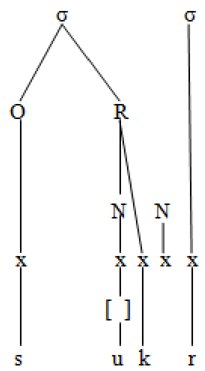
For instance, the vowel melody spread rule above can be applied to the epenthetic vowel [u] in the output [suk**u**r] ‘intoxication’ through three steps. The underlying form being considered in the first step as in (5.29):

(5.29) Underlying form



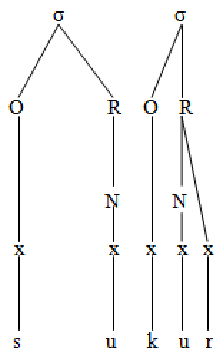
The next step is to insert a vowel slot on the skeletal tier as in (5.30):

(5.30)



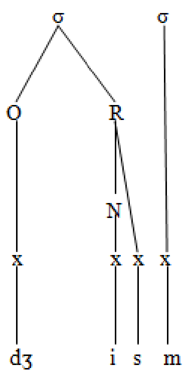
The final step is to fill the empty vowel slot with a vowel identical to the stem one (the spreading of a stem vowel matrix rightward on the skeletal tier) as shown in (5.31):

(5.31)



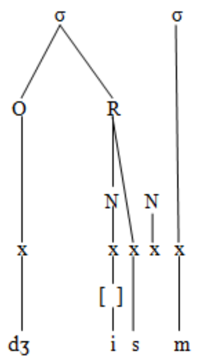
The same steps above are applied to the epenthetic vowel [i] of the output [dʒisi̱m] ‘part’. The first step is to show the underlying form as in (5.32):

(5.32) Underlying form



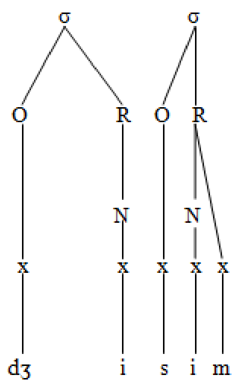
The second step is to insert a vowel slot on the skeletal tier as in (5.33):

(5.33)



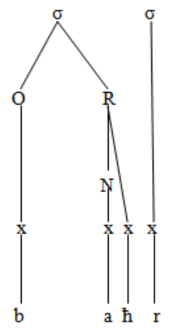
In the final step, the empty vowel slot is filled by the stem vowel through the spreading of a stem vowel matrix rightward on the skeletal tier as in (5.34):

(5.34)



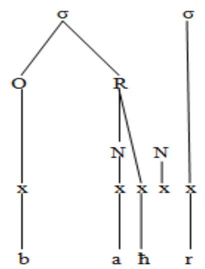
The epenthetic vowel [a] in (5.27 e-f) is conditioned by a [+Pharyngeal] consonant as the first member of a word-final cluster; e.g., /faħm/ → faħ**a**m'coal'. In subsection 3.2.1, Jarrah (1993) states that this rule is known as spreading the [+Phary] feature when a non-emphatic guttural is adjacent to an empty vowel slot. With respect to Jarrah's (1993) finding, the spread of a stem vowel /a/ is conditioned by the first member of a word-final cluster as a [+Phar] consonant. This rule can be applied to the epenthetic vowel [a] of the output [baħ**a**r] 'sea' through three steps. The first step is to show the underlying form of [baħ**a**r] as in (5.35):

(5.35) Underlying form



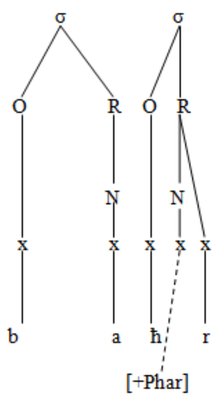
The second step is to insert an empty slot on the skeletal tier as in (5.36):

(5.36)



The final step is to spread the [+Phar] feature to the adjacent vowel slot in order to achieve an epenthetic vowel with a [+Phar] feature, [a], as in (5.37):

(5.37)



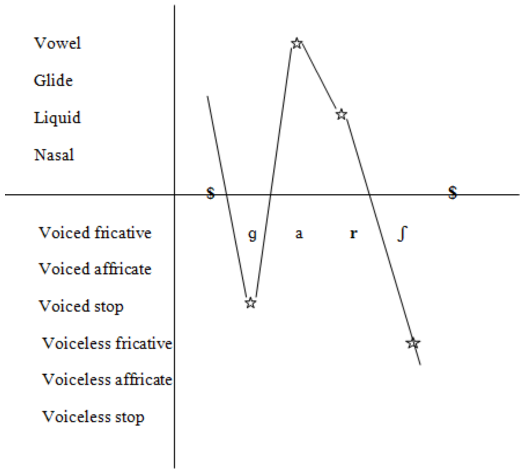
The epenthetic vowel [i] in (5.27 g-h) is determined by the first member of the [-phar] feature followed by [r]. Also, the epenthetic vowel [u] is conditioned by the first member of the [-phar] feature followed by [l]. We will deal with the identity of the epenthetic vowel in depth in subsection 5.3.2.1.5. On the other hand, epenthetic vowels are not allowed in words in which their coda clusters conform to the SSP. This observation is shown in the examples below:

(5.38)

a. /garʃ/	garʃ,	* gar**a**ʃ	‘coin’
b. /samʕ/	samʕ,	*sam**a**ʕ	‘hearing’
c. /ħilm/	ħilm,	*ħil**i**m	‘a dream’
d. /lazg/	lazg,	* laz**i**g	‘plaster’
e. /kalb/	kalb,	*kal**i**b	‘dog’
f. /ʃurb/	ʃurb,	*ʃur**u**b	‘drinking’
g. /liʕb/	liʕb,	*liʕ**i**b	‘playing’
h. /ʃamʕ/	ʃamʕ	*ʃam**u**ʕ	‘wax’
i. /sarg/	sarg	*sar**a**g	‘steal’
j. /girʃ/	girʃ	*gir**i**ʃ	‘shark’
k. /silk/	silk	*sil**i**k	‘silk’
l. /karʃ/	karʃ	*kar**a**ʃ	‘belly’
m. /sˤamʁ/	sˤamʁ	*sˤam**u**ʁ	‘glue’
n. /madd/	madd	*madid	‘he extended’

The above nouns in (5.38) have the surface form without any epenthetic vowels inserted between the last two consonants in the coda position of the underlying form. The reason for this is related to SSP: the two consonants in the coda position do not violate SSP because the second consonant is not more sonorous than the first one which is closer to the peak, unlike the nouns in (5.38). Consider the representation of the output [garʃ] ‘coin’ below:

(5.39) The output [garʃ] ‘coin’



Interestingly, vowel epenthesis is blocked in the final consonant cluster in (5.38-n) because it is assigned as a geminate which represents a single sonority value by being a single unit (McCarthy 1986, Al-Mohanna 1998, Rakhieh 2009). How does OT account for this phenomenon? In fact, the SSP constraint introduced by Roca (1994) is used to eliminate candidates with sonority violation: this constraint outranks the *COMPLEX$_{CODA}$ and DEP constraints. Furthermore, the MAX-C constraint (McCarthy 2008), which disfavours the deletion of consonants, outranks MAX-IO in order to eliminate candidates that are compatible with the SSP through the deletion of peripheral consonants. The candidates of the input /sˤabr/ ‘patience’ and /garʃ/ ‘coin’ will be evaluated in the next tableau:

(5.40) /sˤabr/→ [sˤa.b**u**r]

ONS>>*LLL>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈsˤabr/	ONS	*LLL	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈsˤabr						*!							*	**
☞b. ˈsˤa.b**u**r											*	*		*
c. ˈsˤab.r**i**			*!									*		*
d. ˈsˤab							*!	*						*

Tableau (5.40) identifies candidate (b) as optimal since it crucially escapes violation of SSP and SYLLCON. The SSP constraint successfully disqualifies candidate (a) from being optimal. Likewise, output (c) fails to be optimal due to the violation of the SYLLCON constraint; sonority is raised across the syllable boundary in (c) because /r/, as a liquid, is more sonorous than /b/ as a plosive (**b**.**r**). Candidate (d) avoids the violation of the SSP constraint by the deletion of a peripheral sonorant but this deletion results in the violation of the MAX-C and MAX-IO. Therefore, this candidate is eliminated from being optimal. The candidates of the input /ˈgarʃ/ where the word-final cluster obeys the SSP are evaluated in the tableau (5.41):

(5.41) /ˈgarʃ/→ [ˈgarʃ] 'coin'

ONS>>*LLL>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈgarʃ/	ONS	*LLL	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞ a. ˈgarʃ													*	**
b. ˈga.r**a**ʃ											*!	*		*
c. ˈgar.ʃ**i**												*!		
d. ˈgar							*!	*						*

Candidate (a) is determined in the tableau (5.41) as optimal because it avoids the violation of constraints including MAX-IO, O-CONTIG, and DEP-IO which are violated by the rest of the candidates. The constraints come into effect when all candidates satisfy SSP. The final consonant cluster /-rʃ/ is avoided by internal epenthesis as in candidate (b) and peripheral epenthesis as in candidate (c), but these candidates fail to satisfy the O-CONTIG and DEP-IO constraints. Candidate (d) cannot be optimal since it violates the MAX-C and MAX-IO constraints. The question related to the cases where SSP violation is tolerated will be addressed in (5.3.2.1.3).

5.3.2.1.3 Lexical Distinctness

The discussion above shows that vowel epenthesis in the coda clusters of some monosyllabic nouns of the canonical shape CVCC is motivated by the violation of SSP. Therefore, this type of epenthesis occurs in the middle of a coda cluster between the consonant which is close to the peak and less sonorous and the one which is closer to the margin and more sonorous. However, there is an exceptional case in which epenthetic vowels are not allowed to be inserted in order to solve the violation of SSP in NA. Consider the following example:

(5.42)

a. /gatˤʕ/	[gatˤʕ]	‘cut (n.)’
b. /sˤabʁ/	[sˤabʁ]	‘painting (n.)’
c. /radʒm/	[radʒm]	‘throwing stones (n.)’
d. /rasm/	[rasm]	‘drawing (n.)’
e. /dafʕ/	[dafʕ]	‘paying (n.)’
f. /χatn/	[χatn]	‘circumcising (n.)’
g. /χatm/	[χatm]	‘seal or stamp (n.)’
h. /χabz/	[χabz]	‘baking (n.)’
i. /laʕn/	[laʕn]	‘cursing (n.)’

In (5.42), it is obvious that these words have clusters in the coda position which violate the SSP: i.e. the final clusters in words in (5.42) violate the SSP due to the second member of the coda consonant being more sonorous than the first one. Consequently, the sonority in this case rises upwards once again at a syllable margin. Clements (1990), Blevins (1996), and Carlisle (2001) call this manner of violation as Reverse Sonority, which says where the sonority rises in the coda towards a syllable margin (see subsection 3.2.1).

In subsection 3.2.1, according to Jarrah (1993), there is no epenthetic vowel used to avoid such violations. He states that the explanation that may account for this type of behaviour is related to lexical distinctness. He finds that it is necessary to avoid epenthetic vowels in these cases; otherwise we will end up with nouns that have the same form of the verbs derived from them. Abu-Mansour (1992) found that the morphological classes such as verbs and nouns are considered to be the result of epenthesis.

> “Most sound verbs in Arabic have a CVCVC pattern, while their nouns have CVCC patterns. A verb would be indistinguishable from its respective noun if the epenthesised vowel is identical to the vowel of the first syllable.

> Thus, the noun ***ʔasr*** ‘capture’ does not undergo epenthesis since the result would be identical to the verb ʔas**a**r ‘to capture’**”** (Broselow, Eid and McCarthy, 1992: 48).

The internal vowel epenthesis is blocked in NA when dealing with words in (5.42), even though these words have word-final clusters that constitute Reverse Sonority. The reason for this blockage is to avoid lexical homophony; the lexical category of these words would be derived from verbs when inserting epenthetic vowels between the members of word-final clusters in words in (5.42), i.e. epenthetic vowels are identical to stem vowels. Consider the following examples:

(5.43)

a. /gatˤʕ/	‘cut (n.)’	*[gatˤ**a**ʕ]	‘he cut’
b. /sˤabʁ/	‘painting (n.)’	*[sˤab**a**ʁ]	‘he painted’
c. /radʒm/	‘throwing stones (n.)’	*[radʒ**a**m]	‘he threw stones’
d. /rasm/	‘drawing (n.)’	*[ras**a**m]	‘he drew’
e. /dafʕ/	‘paying (n.)’	*[daf**a**ʕ]	‘he paid’
f. /χatn/	‘circumcising (n.)’	*[χat**a**n]	‘he circimsized’
g. /χatm/	‘seal or stamp (n.)’	*[χat**a**m]	‘he stamped’
h. /χabz/	‘baking (n.)’	*[χab**a**z]	‘he baked’
i. /laʕn/	‘cursing (n.)’	*[laʕ**a**n]	‘he cursed’

The epenthetic vowel [a] which is identical to the stem vowel in words in (5.43) results in changing the lexical category of these words. In other words, the nouns in (5.43) are derived from the noun form /faʕl/ of the canonical shape /CaCC/. This form would be changed to the verb form /faʕal/ by inserting a vowel [a] between /ʕ/ and /l/. Accordingly, the nouns in (5.43) of the form /faʕl/ would be derived from the verb form /faʕal/ by inserting the epenthetic vowel [a] between the members of word-initial clusters. Therefore, in order to maintain the lexical category of nouns above, this type of sonority violation should be tolerated rather than breaking the final consonant cluster by inserting the vowel [a]. Although nouns to verb changes do occur in the language, here, in the syntactic context where a noun is required, an epenthetic [a] would erroneously create a verb. Therefore, maintaining the correct syntactic category takes precedence over a phonological structure violation. The question related to the extent to which sonority violation is tolerated in some word-final clusters has been addressed in this subsection. The answer to this question is that Reverse Sonority in word-final position in underlying forms is tolerated in order to avoid any change of lexical category of words, as seen in (5.43) while the type of sonority violation is tolerated in the surface form when dealing with some complex onsets in NA that are created by syncope or CV-metathesis, as discussed in subsection 5.3.2.1. The identity of epenthetic vowels in NA will be discussed next.

5.3.2.1.4 Identity of Epenthetic Vowels

In CVCC type nouns, if the last two consonants in the coda position violate the SSP, the epenthetic vowel either [i], [u], or [a] is inserted between members of those clusters. However, is it possible to say that the behaviour of alternating vowels is determined by certain factors, or is it haphazard? As discussed in subsection 5.3.2.1.2, the epenthetic vowel [a] results from the spreading of the stem vowel /a/ which is conditioned by the first member of a word-final cluster as a [+Phar] consonant. In other words, the epenthetic vowel [a] is determined by the stem vowel /a/ and a [+Phar] consonant as the first member of a word-final cluster. In the same subsection, an epenthetic vowel will be identical to the stem vowel if the stem vowel is either /i/ or /u/. In other words, [i], for example, is employed as an epenthetic vowel when the stem vowel is /i/, and the same thing happens with the epenthetic vowel is [u]. Consider the following examples:

(5.44)

(I)	a. /baħr/	baħ**<u>a</u>**r	‘sea’
	b. /nahr/	nah**<u>a</u>**r	‘river’
	c. /ʃaʕr/	ʃaʕ**<u>a</u>**r	‘hair’
	d. /naχl/	naχ**<u>a</u>**l	‘plam trees’
	e. /laʁm/	laʁ**<u>a</u>**m	‘mine’
(II)	a. /ʔiðn/	ʔið**<u>i</u>**n	‘ear’
	b. /tˤifl/	tˤif**<u>i</u>**l	‘baby’
	c. /dʒism/	dʒis**<u>i</u>**m	‘body’
(III)	a. /gutˤn/	gutˤ**<u>u</u>**n	‘cotton’
	b. /ħukm/	ħuk**<u>u</u>**m	‘verdict’

In (5.44-I), the epenthetic vowel [a] is determined by the stem vowel /a/ and a [+Phar] consonant, as the first member of a word-final cluster, i.e. the spread of the stem vowel /a/ is conditioned by the first member of a word-final cluster, as [+Phar]. In (5.44-I,II), the epenthetic vowels [i] and [u] are determined by their identical stem vowels. The spread of the stem vowel /a/ is blocked if the first member of a word-final cluster is not a [+Phar] consonant. To simplify this point, here are some examples of various environments in (5.45) below:

(5.45)

(I)	a. /ʕagl/	ʕag**i̲**l	'mind'
	b. /ʔakl/	ʔak**i̲**l	'food'
	c. /fasˤl/	fasˤ**i̲**l	'chapter/season/class'
	d. /ħabl/	ħab**i̲**l	'rope'
(II)	a. /sˤabr/	sˤab**u̲**r	'patience'
	b. /fadʒr/	fadʒ**u̲**r	'dawn'
	c. /nasr/	nas**u̲**r	'eagle'
	d. /tamr/	tam**u̲**r	'dates'

The spread of a stem vowel /a/ is blocked in the outputs in (5.45-I, II) due to the first members of word-final clusters as [-Phar]. The epenthetic vowels [u] and [i] in (5.45-I, II) are determined by the second member of the cluster. For instance, the epenthetic vowel [i] is conditioned by /l/, as a second member of the word-final cluster while the epenthetic vowel [u] is determined by the second member of a word-final cluster: i.e. /r/.

To conclude, the identity of epenthetic vowels is determined by a stem vowel if it is either /i/ or /u/ as in [ʔið**i̲**n] 'ear' and [ħuk**u̲**m] 'verdict'. The spread of the stem vowel /a/ is conditioned by a [+phary] consonant of the first member of a word-final cluster. This spreading is blocked when the first member of a word-final cluster is [+Phar], whereas the identity of epenthetic vowels in this case would be determined by the second member of a word-final cluster: i.e. the epenthetic vowel [i] is conditioned by /l/ and the epenthetic vowel [u] is determined by /r/. However, there is another factor that motivates internal epenthesis as well as sonority violation, and it is related to the position of non-final superheavy syllables that are associated with consonant-initial affixes. This is discussed in the next section.

5.3.2.2 Non-final Superheavy Syllables with Consonant-Initial Suffixes

Superheavy syllables in most modern Arabic dialects, including NA, cannot occupy non-final positions due to a well-understood restriction on the distribution of these syllables which consequently bans them from being in non-final position, according to Bakalla (1973), Broselow (1976,1980), Al-Mozainy (1981), McCarthy (1981), Irshied (1984), Itô (1986,1989), Abu-Mansour (1987), Al-Mohanna (1998), Kiparsky (2003), Watson (2007), and Bamakhramah (2009), as mentioned in subsection 3.2.3. Non-final superheavy syllables in Arabic are heavy syllables of the forms CVC or CVV followed by semisyllables, according to Bamakhramah (2009); i.e. /CVV.C_{μ}.CV/ and /CVC.C_{μ}.CV/ Therefore, according to Al-Mohanna (1994), epenthesis, as a technique, is used to prevent these syllables from occurring in non-final positions. This implies that vowel epenthesis occurs when superheavy syllables in either nouns or verbs are suffixed with consonant-initial affixes; e.g., /gal.b_{μ}-ha/→[galb**<u>a</u>**ha] ‘her heart’ or /be:.t_{μ}-hum/→/be:t**<u>i</u>**hum/ ‘their house’ (Ingham 1994). However, in section 3.2.3 and subsection 4.8, Broselow (1992, 1997) and Watson (2007) agree that non-final superheavy syllables of the form CVVC can be avoided by mora sharing rather than vowel epenthesis; this idea will be illustrated in depth in subsection 5.3.3.1. If the affix is vowel-initial, then there is no need for an epenthetic vowel or mora sharing because this affix will be occupied as a nucleus of a newly created syllable with the last segment of the non-final CVVC or CVCC syllables as the onset. What this means is that these syllables will no longer exist in the non-final positions:

(5.46)

a. /be:.t_{μ}-ah_{OBJ}/ → [bee.tah_{OBJ}] ‘his house’ (CVVC. VC→ CVV.CVC)

b. /ʃif.t_{μ}-ah_{OBJ}/ → [ʃif.tah_{OBJ}] ‘you saw him.’ (CVCC. VC → CVC.CVC)

The examples in (5.46) draw attention to a coda that is syllabified as an onset of a following syllable due to the initial vowel suffixes. This phenomenon will be illustrated below. Turning to the main point, the cases that involve epenthesis will be accounted for in the next subsections. Also, the next subsections will answer the question about the way non-final superheavy syllables of the forms CVVC and CVCC are avoided in NA.

5.3.2.2.1 CVVC in Non-final Position

Ingham (1994) observes that non-final superheavy syllable of the form CVVC motivates an epenthetic vowel [i] in NA. As a result, epenthesis is employed to create a new syllable. Therefore, superheavy syllables will no longer exist in non-final position. Ingham (1994) offers some examples which show how vowel epenthesis is motivated by nouns and verbs of the canonical shape CVVC when they are suffixed with consonant-initial affixes:

(5.47)

a. /be:.t_{μ}-ha_{POSS}/ → [be:.t**i̠.** ha_{POSS}] ‘her house’ (CVVC.CVC → CVV.CV.CVC).

b. /ʃa:.f_{μ}-na_{OBJ}/ → [ʃa:.f**i̠.**na_{OBJ}] ‘he saw us’ (CVVC.CV→ CVV.CV.CV).

c. /ʃa:.f_{μ}-hum_{OBJ}/ → [ʃa:.f**i̠**.hum_{OBJ}] ‘he saw them’ (CVVC.CV→CVV.CV.CVC).

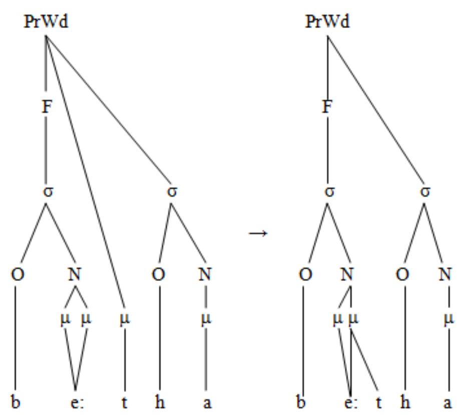
d. /dʒa:.b_{μ}-na_{OBJ}/ → [dʒa:.b**i̠**.na_{OBJ}] ‘he brought us’ (CVVC.CV→ CVV.CV.CV).

He shows that the epenthetic vowel, either [a] or [i], is inserted when the non-final superheavy syllable of the form CVVC is suffixed with a consonant-initial affix. However, some observations on Ingham's (1994) claim are relevant here. First, he does not refer to Adjunction-to-mora which is introduced by Broselow (1992) and which says that a mora can dominate two segments. Also, he does not refer to the fact that the notion of semisyllable in some cases motivates vowel epenthesis, even though this notion has been used in analysing Arabic by Aoun (1979), Selkirk (1981), and Broselow (1992).[46] In subsection 2.5.2, Kiparsky (2003) and Watson (2007) examined the presence of semisyllables at the word level (lexical or underlying form) and postlexical level (surface form) or at one of these levels. They found that dialects which belong to the C-dialect group preserve semisyllables at both levels. Expressed more simply, they realised that semisyllables are permitted at both levels in the C-dialect group, whereas they are permitted at the word level only in the VC- dialects. Unlike these two groups, the CV-dialect group does not permit semisyllables at all (Kiparsky 2003 and Watson 2007) (see subsection 2.5.2). According to their findings, a semisyllable can be either affiliated to the syllable node as a non-moric consonant if an epenthetic vowel is inserted after it where it represents a new nucleus of an internal syllable, whereas a

[46] Kiparsky (2003) and Watson (2007) define semisyllables as moraic consonants that are unaffiliated to the syllable node.

semisyllable will be non-moraic by resyllabifying it as an onset of the next newly-created syllable. Alternatively, a semisyllable might share its mora with a previous syllable (non-final syllable). This leads to two very important questions. The first question is specific to the way a semisyllable shares its mora with a preceding or non-final syllable. The second question is related to the way a semisyllable motivates vowel epenthesis. In the Central NA, the main focus in this thesis, there is no epenthetic vowel inserted to affiliate a semisyllable to a syllable node in a case in which a semisyllable precedes a non-final syllable of the form CVVC, unlike in the Northern Najdi group of dialects such as Qasimis, Shammaris, Dhafiris, and generally Anizah. (Ingham, Personal communication, 14th October 2012). This semisyllable can be affiliated to a syllable node by sharing its mora with a non-final syllable that contains a long vowel. As demonstrated in section 3.4, this process is particular to Adjunction-to-Mora which was introduced by Broselow (1992: 14-15) as a rule creating moras that dominate two segments. Consider the following representation of [be:t.ha] 'her house' which shows mora sharing:

(5.48)



As shown in the representation above, a semisyllable consonant /-t_{μ}-/ which is moraic, of course, is affiliated to a non-final syllable, of the form CVVC, by sharing its mora with the second vowel rather than being affiliated to a newly-created syllable in which an epenthetic vowel represents its nucleus. Such behaviour is accounted for within OT. The following constraint will be used in the following tableau:

(5.49)

*3μ (Kager 1999):

No trimoraic syllables.

The constraint in (5.49) will be highly-ranked in order to eliminate any candidate with a trimoraic syllable. In the next tableau, I evaluate the candidate analyses of the input /be:.t_{μ}.ha/ ‘her house’

(5.50)

ONS>>*LLL>> *3μ>>*[VP>>SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *$COMPLEX_{ONS}$ >> O-CONTIG >>DEP>> *$COMPLEX_{CODA}$ >>*CODA

/ˈbe:.t_{μ}-ha_{OBJ}/	ONS	*LLL	*3μ	*[VP	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*$COMPLEX_{ONS}$	O-CONTIG	DEP-IO	*$COMPLEX_{CODA}$	*CODA
μμ μ a. ˈbe:t. ha					*!										*	**
μμ μ μ b. ˈbe: t. ha			*!		*											*
μμ μ μ ☹c .ˈbe:. t<u>i</u>. ha														*		
μμ μ d. ˈbet. ha					*!					*	*					*

Candidate (c) is identified as optimal because it avoids the violation of *3μ and SYLLCON constraints. The *3μ constraint is violated by candidate (b). Candidates (a) and (d) fail to satisfy the *SYLLCON constraint. In order to determine candidate (a) as optimal, there should be a constraint that can eliminate candidate (c) from being optimal. The following constraint can be employed to to do this job:

(5.51)

*CVV.CV$]_{\sigma}$

The unstressed light penultimate syllable that follows a heavy antepenultimate syllable of the form CVV is not allowed.

The constraint in (5.51) will be outranked the SYLLCON constraint in order to assign candidate (a) as optimal. Consider the following tableau:

(5.52)

ONS>>*LLL>> *3μ>>*[VP>>*CVV.CV]$_{\sigma}$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>>MAX-C>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈbe:.t$_{\mu}$-ha$_{OBJ}$/	ONS	*LLL	*3μ	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ ☞a.ˈbe:t. ha						*										*	**
μμ μ μ b.ˈbe:. t. ha			*!			*											*
μμ μ μ c.ˈbe:. t**i**. ha					*!										*		
μμ μ d.ˈbet. ha						*					*!	*					

The avoidance of the violation of *3μ, *CVV.CV]$_{\sigma}$, and MAX constraints results in assigning candidate (a) as optimal. Candidate (b) fails to be optimal due to the violation of the *3μ constraint.The *CVV.CV]$_{\sigma}$ constraint is violated by candidate (c). Therefore, this candidate is eliminated from being optimal. Candidate (d) satisfies the *3μ and *CVV.CV]$_{\sigma}$ constraints but it violates the MAX-IO constraint.

Mora sharing was explained in this subsection as a tool used to avoid non-final superheavy syllables in NA. This process was applied to a semisyllable that follows a non-final syllable that has a long vowel. The second member of a long vowel and a semisyllable were directly linked to one mora. However, is mora sharing applicable to non-final CVCC as well as non-final CVVC? This question will be taken into consideration in the next subsection.

5.3.2.2.2 CVCC in Non-final Position

As mentioned in subsection 3.2.3, scholars including Bakalla (1973), Broselow (1976,1980), Al-Mozainy (1981), McCarthy (1981), Irshied (1984), Itô (1986,1989), Abu-Mansour (1987), Al-Mohanna (1998), Kiparsky (2003), Watson (2007), and Bamakhramah (2009) crucially report that CVCC syllables in most modern Arabic dialects, including NA, are not allowed in non-final positions, but they are mostly found in the final position where their final segments become extrasyllabic.[47] In other words,

[47] Watson (2002:92) mentions that CVCC is restricted to the final position in the syllable domain. The last segment becomes extrasyllabic which means that it is not counted as one of the constituents that are

the final CVCC is heavy rather than superheavy since the last segment is outside the syllable domain. In NA, there is a rather more restriction which prevents these syllables from occupying the non-final position when they are suffixed with consonant-initial affixes because a mora cannot be shared by the last two consonants in non-final CVCC syllables, compared to CVVC.[48] Therefore, it is necessary to insert a vowel in order to avoid trimoraic syllables as long as mora sharing is blocked in this case. See the following examples:

(5.53)

I. a. /ʃif.t$_{\mu}$-kum$_{\text{OBJ}}$/ → [ʃif.t**i̲**.kum$_{\text{OBJ}}$] ‘I saw you’m.pl.’ (CVCC.CVC→ CVC.CV.CVC)

b. /ʔin.s$_{\mu}$-ha/→ [ʔin.s**a̲**.ha$_{\text{OBJ}}$] ‘forget her’ (CVCC.CV→ CVC.CV.CV)

II. a. /gal.b$_{\mu}$-na$_{\text{OBJ}}$/ → [gal.b**i̲**.na$_{\text{OBJ}}$] ‘our heart’ (CVCC.CVC→CVC.CV.CVC)

b. /bin.t$_{\mu}$-na$_{\text{OBJ}}$/ → [bin.t**i̲**.na$_{\text{OBJ}}$] ‘our daughter’ (CVCC.CVC→ CVC.CV.CVC)

III. a. /baħ.r$_{\mu}$-hum$_{\text{OBJ}}$/ → [ba.ħ**a̲**r.hum$_{\text{OBJ}}$] ‘their sea’ (CVCC.CVC → CV.CVC.CVC)

b. /ʔið.n$_{\mu}$-ha$_{\text{OBJ}}$/ → [ʔi.ð**i̲**n.ha$_{\text{OBJ}}$] ‘her ear’ (CVCC.CVC → CV.CVC.CVC)

As shown in the examples above, a consonant-initial affix is suffixed to a verb in (5.53-I) and nouns in (5.53-II,III) of the form CVCC. The epenthetic vowels [a] and [i] are functionally used to avoid non final superheavy syllables; i.e. CVCC. The identity of these epenthetic vowels is determined by the adjacent consonants. For instance, the epenthetic vowel [a] is determined by the adjacent guttural /h/ in the output [ʔin.s**a̲**.**h**a] while the epenthetic vowel [i] is not adjacent to any guttural consonants, as in the output [ʃif.t**i̲**.kum]. Likewise, the epenthetic vowel [i] in the outputs in (5.53-II) are not adjacent to any guttural consonants. In (5.53-III), the epenthetic vowel [a] in the output [ba.ħ**a̲**r.hum] is conditioned by the stem vowel /a/ and the preceding guttural consonant /ħ/, whereas the epenthetic vowel [i] is determined by the stem vowel [i], i.e. this epenthetic vowel is not adjacent to any guttural consonant.

part of the syllable domain with reference to Carirene and San’ani Arabic. Extrasyllabicity is also used by Aoun (1979), Selkirk (1981), and Kenstowicz (1994:274), among others.

[48] Farwaneh (1995) and McCarthy (2007) argue that non-final CVCC is found in some dialects because the two consonants are attached to one mora if these consonants conform to the SSP (see subsection 3.2.3).

Epenthetic vowels in (5.53) do not occur in the same place, but depend on the final clusters in CVCC syllables. Again, the epenthetic vowels [a] and [i] occur after the second member of the final cluster in (5.53-I,II) but these vowels sometimes occur between the members of the final cluster in (5.53-III). This leads to a very important question related to the place of an epenthetic vowel in (5.53-I,II) and (5.53-III). Why do these vowels occur between the members of final consonant clusters in (5.53-III) compared to (5.53-I) and (5.53- II)? In subsection 3.2.3, I discussed that Abu-Mansour (1987) reports that prepausal epenthesis is conditioned by the violation of the SSP with; e.g., /ħu**sn**/→ [ħus**u**n] ‘beauty. She states that the place of an epenthetic vowel is changed if vowel epenthesis is conditioned by the attachment of a consonant-initial suffix in order to avoid non-final superheavy syllables; e.g., /ħu**sn**-ha$_{OBJ}$/→ [ħus.n**a**.ha$_{OBJ}$] ‘her beauty’. There are two things occurring in such behaviour: firstly, the place of vowel epenthesis is changed due to the attachment of a consonant-initial suffix. Secondly, the epenthetic vowel is [a] because it is adjacent to a guttural consonant /h/. In NA, however, prepausal epenthesis is conditioned by sonority violation, even if the word is suffixed with a consonant-initial suffix; e.g. /nahr/→ [na.h**a**r] →/-na$_{OBJ}$/→ [na.h**a**r.na$_{OBJ}$] ‘our river’, /baħr /→ [baħ**a**r] →/-hum$_{OBJ}$/→ [ba.ħ**a**r.hum$_{OBJ}$] ‘their sea’. Unlike vowel epenthesis in (5.53-III), vowel epenthesis in (5.53-I, II) is found between the final consonant cluster of the non-final syllable and a consonant-initial suffix since there is no sonority rising across the syllable boundary. Otherwise, if prepausal epenthesis is in a word /galb-na/, for example, then there will consequently be rising sonority across the syllable boundary; i.e. /galb-na$_{OBJ}$/→*[ga.li**b**.**n**a].

There are two questions mentioned in the previous subsection. The first question is related to a semisyllable sharing its mora with a preceding or non-final syllable while the second question is specific to a semisyllable as a motivator for internal epenthesis. A semisyllable is affiliated to a syllable node by sharing its mora with a non-final syllable that has a long vowel when a CVVC syllable is associated with a consonant-initial affix, as in (5.48), whereas mora sharing is not applied with a semisyllable that follows a heavy syllable of the form CVC, especially when this syllable is associated with a consonant-initial affix. Therefore, vowel epenthesis is necessary to affiliate a semisyllable to a syllable node, as in (5.54):[49]

(5.54)

a. /ʃif.t$_\mu$.kum$_{OBJ}$/ → [ʃif.t**i̲**.kum$_{OBJ}$] 'I saw you' m.pl.' (CVC.C$_\mu$.CVC→ CVC.C**V̲**.CVC)

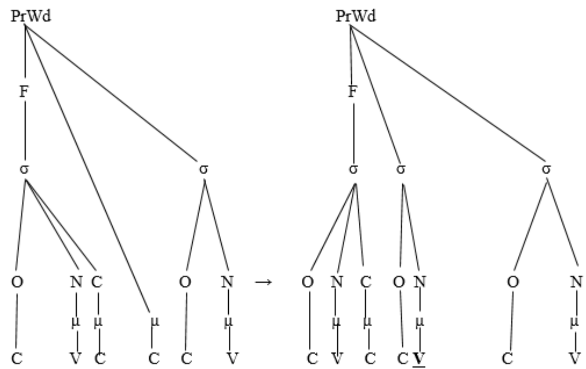
b. /ʔin.s$_\mu$.ha$_{OBJ}$/→ [ʔin.s**a̲**.ha$_{OBJ}$] 'forget her' (CVCC.CV → CVC.CV.CV)

c. /gal.b$_\mu$.na$_{POSS}$/ → [gal.b**i̲**.na$_{OBJ}$] 'our heart' (CVCC.CVC→ CVC.CV.CVC)

d. /bin.t$_\mu$.na$_{POSS}$/ → [bin.t**i̲**.na$_{POSS}$] 'our daughter' (CVCC.CVC→ CVC.CV.CVC)

As illustrated in (5.54), it is obvious that semisyllables are permitted at the word level, whereas they are affiliated to the syllable nodes by inserting an epenthetic vowel [i]. As a result, semisyllables will no longer be moraic, because they are resyllabified as an onset of the newly created syllables in which the epenthetic vowel [i] represents their nucleus. In NA, a semisyllable must be affiliated to a syllable node either by sharing its mora with a non-final superheavy syllable of the form CVVC, or be resyllabified as an onset of a newly-created syllable in which the epenthetic vowel [i] represents its nucleus. Mora sharing cannot be implemented in this case because a non-final superheavy syllable does not have a long vowel. Therefore, the epenthetic vowel [i] must be inserted after a semisyllable to resyllabify this consonant as an onset of the following syllable. This observation is illustrated by the representation of non-final CVCC that is associated with a consonant-initial affix:

(5.55)



[49] Scholars including Aoun (1979), Selkirk (1981), McCarthy & Prince (1990a,1990b), Broselow (1992), Farwaneh (1995), Kiparsky (2003), Watson (2007), and Rakhieh (2009) agree that CVCC is deemed a normal syllable followed by a semisyllable; i.e., /CVC.C$_\mu$ /. Moreover, Kaspersky (2003), Watson (2007), and Rakhieh (2009) state that CVVC also is considered a normal syllable followed by a semisyllable; i.e. /CVV.C$_\mu$/.

The representation above shows that a semisyllable is resyllabified as an onset of the following syllable in which an epenthetic vowel is occupied as its nucleus. This epenthesis occurs after a semisyllable which demonstrates the fact that NA is one of the CV-dialects as discussed by Kiparsky's (2003) and Watson (2007) (see subsection 2.5.2). This behaviour undergoes the analysis of OT in the next tableau in which the candidates of the input /bin.t_{μ}-na/ are evaluated by the same constraint ranking in (5.56):

(5.56)

ONS>>*LLL>> *3μ>>*[VP>>*CVV.CV]$_{\sigma}$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>> MAX-IO>> MAX-μ-IO >>*COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/bin.t_{μ}-na$_{POSS}$/	ONS	*LLL	*3μ	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ a. ˈbint.na						*!										*	**
μμμ μ b. ˈbint. na			*!			*										*	**
μμ μ μ ☞c. ˈbin.ti. na															*		*
μ μμ μ d. ˈbi.nit. na						*!								*	*		*

Output (c) is selected to be optimal in the tableau (5.56) due to the satisfaction of highly-ranked constraints. Output (b) violates the *3μ due to a trimoraic syllable. Outputs (a) and (d) fail to be optimal because both candidates equally violate the SYLLCON constraint which is highly-ranked.

A non-final CVCC is avoided by vowel-initial affixes without seeking for an epenthetic vowel because the last consonant in this syllable will be resyllabified as an onset of the following syllable.[50] Consider the following examples:

(5.57)

a. /gil.t_{μ}-u_{OBJ}/→ [gil.tu_{OBJ}] 'you (pl.) said'

b. /gil.t_{μ}-i_{OBJ}/→ [gil.ti_{OBJ}] 'you (sm. sg.) said'

[50] This behaviour is also observed by Abu-Mansour (1987) in Meccan Arabic; e.g., /ʔism-i/→[ʔis.mi] 'my name'.

c. /ga:.l_{μ}-u_{OBJ}/→ [ga:.lu_{OBJ}] 'they said'

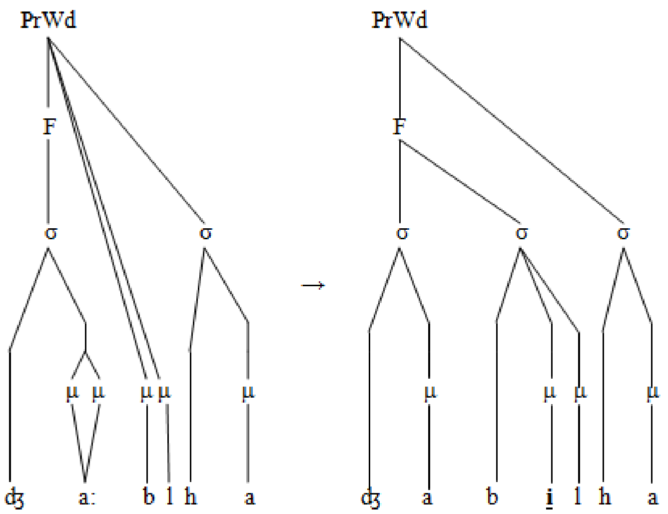
The examples above show that both mora sharing and vowel epenthesis are not necessary to avoid non-final superheavy syllables CVVC and CVCC when they are suffixed with a vowel-initial affix because the last consonant in these syllables are re-syllabified as an onset of the following syllable.

To conclude, in this subsection, I explained how the non-final superheavy syllables of the form CVVC and CVCC that are associated with consonant-initial affixes are avoided in NA either by mora sharing or an epenthetic vowel. The non-final superheavy syllable CVVC is avoided by mora sharing when associated with a consonant-initial affix, or by resyllabifying the last consonant as an onset of the following syllable when a non-final CVVC is suffixed with a vowel-initial affix as well as non-final CVCC. However, a non-final CVCC cannot be tolerated when it is followed by a consonant-initial affix, because it would then be a trimoraic syllable. Furthermore, it does not permit mora sharing since its final consonant cluster is not a geminate. Therefore, an epenthetic vowel is necessary to prevent this, resulting in three syllables, including a newly created syllable in which an epenthetic vowel is employed as its nucleus; i.e./CVCC.CV/→vowel epenthesis → [CVC.C**V**.CV]. However, the question related to the avoidance of non-final superheavy syllables will not yet be been addressed, until the dative suffixes, /-l-/ and /-b-/, plus initial vowel or consonant-initial affixes, are encompassed in the discussion regarding the presence of non-final superheavy syllables. I analysed some cases in which a non-final superheavy syllable is preceded by vowel or consonant-initial affixes while the case of non-final superheavy syllables that are associated with datives plus consonant or vowel-initial suffixes, and these cases are not yet covered. This case will be dealt with in the next subsection in detail through an OT analysis.

5.3.2.2.3 Non-final superheavy syllables with dative suffixes

In the previous subsection, the non-final superheavy syllables of the form CVCC were revealed as one of the motivators for epenthesis in NA, especially if they are associated with consonant-initial suffxes. I also pointed out how vowel epenthesis is blocked when a non-final superheavy syllable CVCC is suffixed with a vowel-initial affix. As a result, the last consonant will be resyllabified as an onset of the following syllable. In this section, the main focus will be on how semisyllables created by the non-final superheavy syllables of the form CVVC and CVCC and the dative affixes /-l-/ ‘for/to’ and /-b-/ ‘by/with’ are treated in NA. Is it possible to affiliate them to a syllable node by mora sharing or vowel epenthesis? In NA, two semisyllables that are created by the non-final CVVC and a dative are affiliated to a syllable node by epenthesis if the non-final CVVC is followed by the dative and a consonant-initial suffix; e.g., /ʤaa.b_{μ}.l_{μ}-ha/→ [ʤa.ˈb**i̲**l.ha] ‘he brought to her’. The representation of /ʤa:.b_{μ}.l_{μ}-ha/ is shown below:

(5.58)



The representation (5.58) shows that both semisyllables are affiliated to a syllable node by an epenthetic vowel rather than mora sharing, i.e. mora sharing and vowel epenthesis cannot be used together in such a case where the non-final CVVC is followed by a dative plus a consonant-initial suffix. As a result, the first semisyllable /b/ loses its moracity by being resyllabified as an onset of the following syllable (newly created syllable) in which an epenthetic vowel [i] is employed as its nucleus, whereas the second semisyllable is still moraic since its resyllabified as a coda of the same syllable. Instead of mora sharing, vowel shortening targets a long vowel in a non-final syllable of the form CVV in order to avoid an unstressed heavy syllable. This behaviour will be discussed in the next section 5.4. The candidates of the input /ʤa:.b_{μ}.l_{μ}-ha_{OBJ}/ ‘he brought to her’ will be evaluated in the next tableau:

(5.59)

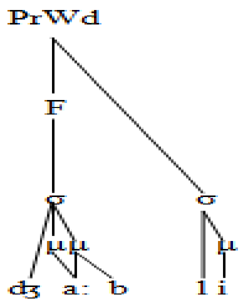
ONS>>*LLL>> *3μ>>*[VP>>*CVV.CV]$_{\sigma}$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>>MAX-C>> MAX-IO>> MAX-μ-IO >>*COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ʤa:.b$_{\mu}$.l$_{\mu}$-ha$_{OBJ}$/	ONS	*LLL	*3μ	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ μ ☞ a. ʤa.ˈbil. ha											*	*		*	*		*
μμ μ μ b. ˈʤa:b.li.ha						*!											*
μμ μ μ μ c. ˈʤa:.ba.la.ha		*!													**		

The tableau (5.59) identifies candidate (a) as optimal since it avoids the violation of the *LLL and SYLLCON constraints, while these constraints are violated by candidates (b), (c), and (d). Candidate (b) violates the SYLLCON constraint due to rising sonority across a syllable boundary. Candidate (c) avoids the violation of the SYLLCON constraint by permitting two epenthetic vowels but it fails to satisfy the *LLL constraint.

On the other hand, mora sharing is used to affiliate a first semisyllable to a pre-final syllable when a non-final CVVC is preceded by a dative plus a vowel-initial suffix; e.g., /ʤa:.b$_{\mu}$.l$_{\mu}$-i$_{OBJ}$/→ [ʤa:b.li$_{OBJ}$] ‘he brought to me’. The representation of [ʤa:$^{\mu\mu}$b.li] is shown below:

(5.60)



The representation (5.60) shows that vowel epenthesis is blocked when a non-final CVVC is followed by both dative and a vowel-initial affix, where mora sharing is used to affiliate the first semisyllale /b/ to a preceding syllable. As a result, this semisyllable and the second member of a long vowel are directly linked to a mora; i.e. they share a mora. A dative /l/ which is considered to be a second semisyllable is affiliated to a syllable node by resyllabifing it as an onset of the following syllable. Simply put, the semisyllable /l/ here does not motivate vowel epenthesis since it is preceded by a vowel-initial affix. Consequently, it is added to a vowel-initial affix as an onset in order to avoid an onsetless syllable. In the following tableau, I will evaluate the candidates of the input /ʤa:.$b_{μ}$.$l_{μ}$-i_{OBJ}/ 'he brought to me'.

(5.61)

ONS>>*LLL>> *3μ>>*[VP>>*CVV.CV]$_σ$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>>MAX-IO>> MAX-μ-IO >>*COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈʤa:.$b_{μ}$.$l_{μ}$-i_{OBJ}/	ONS	*LLL	*3μ	*[VP	*CVV.CV]$_σ$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ ☞a. ˈʤa:b.li						*											*
μμμ μ b.ˈʤa:b.li			*!			*											*
μμ μ μ c. ˈʤa:.ba.li					*!										*		
μμ μ d. ˈʤab.li						*					*!	*					*

Candidate (a) is identified as optimal since it avoids the violation of constraints including *3μ,*CVV.CV]$_σ$, and Max-IO. Candidate (b) has a trimoraic syllable which does not comply with the *3μ constraint. The same constraint is satisfied by candidate (c) through inserting an epenthetic vowel [a] after a semisyllable. However, this vowel epenthesis results in the form CVV.CV where the penultimate syllable is unstressed. Therefore, this candidate violates the *CVV.CV]$_σ$ constraint. The MAX-IO constraint is violated by candidate (d). For this reason, this candidate cannot be optimal.

Semisyllables that are created by non-final CVCC and a dative are affiliated to a syllable node by vowel epenthesis. This is shown by examples in (5.62):

(5.62)

(i) The concatenation of dative plus a vowel-initial affix

a. /gil.$t_{μ}$-$l_{μ}$-i_{OBJ}/ gil.t<u>i</u>.li_{OBJ} 'you said to me'

b. /ʃif.$t_{μ}$-$b_{μ}$-ah_{OBJ}/ ʃif.t<u>i</u>.bah_{OBJ} 'I saw with it'

c. /dʒib.t_{μ}-l_{μ}-ah_{OBJ}/ dʒib.t**i̲**.lah_{OBJ} ‘You brought for him’

d. /gil.t_{μ}-b_{μ}-ah_{OBJ}/ gil.t**i̲**.bah_{OBJ} ‘I said with it’

(ii) The concatenation of dative plus a consonant-initial affix

a. /gil.t_{μ}-l_{μ}-kum_{OBJ}/ gil.t**i̲**l.kum_{OBJ} ‘I said to you (plural form)’

b. /ʃif.t_{μ}-b_{μ}-ha_{OBJ}/ ʃif.t**i̲**b.ha_{OBJ} ‘I saw with it’

c. /gil.t_{μ}-l_{μ}-hum_{OBJ}/ gil.t**i̲**l.hum_{OBJ} ‘I said to them’

d. /riħ.t_{μ}-l_{μ}-hum_{OBJ}/ riħ.t**i̲**l.hum_{OBJ} ‘I went to them’

As shown in examples in (5.62), semisyllables motivate vowel epenthesis since they are followed by vowel-initial and consonant-initial affixes. However, there is a difference between semisyllables in (5.62-i) and (5.62-ii) particular to the way they are affiliated to a syllale node. In (5.62-i), datives /l/ and /b/, as the second semisyllables, are affiliated to syllable nodes by being resyllabified as the onsets of the following syllables since the attached suffixes start with vowels (vowel-initial affixes) in order to avoid onsetless syllables, but the first semisyllables are affiliated to syllable nodes by permitting epenthetic vowels after them. In (5.62-ii), the first and second semisyllables are affiliated to syllable nodes by vowel epenthesis since the attached suffixes are consonant-initial affixes. The first semisyllable loses its moracity since it has been resyllabified as an onset of a newly created syllable in which the epenthetic vowel is functionally employed as its nucleus, whereas the second semisyllable, the dative, is still moraic by being resyllabified as a coda of the same new syllable. This behaviour needs to be accounted for using OT. In this case, the candidates of the input /gil.t_{μ}-l_{μ}-i_{OBJ}/ ‘you said to me’ and /gil.t_{μ}-l-hum_{OBJ}/ ‘I said to them’ will be evaluated in the next tableaux:

(5.63)

ONS>>*LLL>> *3μ>>*[VP>>*CVV.CV]$_{\sigma}$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/gil.t$_{\mu}$-l$_{\mu}$-i$_{OBJ}$/	ONS	*LLL	*3μ	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ a. gilt. li						*!										*	***
μμμ μ b. ˈgilt. li			*!			*										*	***
μμ μ μ ☞ c. ˈgil.ti. li															*		**
μ μμ μ d. gi.ˈlit. li						*!								*	*		*

The tableau (5.63) selects candidate (c) as optimal because this candidate satisfies the *3μ and SYLLCON constraints, unlike the rest of candidates. The *3μ is not satisfied by candidate (b) which has a tri-moraic syllable while candidate (a) avoids the violation of the same constraint by mora sharing but it fails to avoid violating the SYLLCON constraint. Therefore, this candidate is prevented from being optimal, as is candidate (d). The candidates of the input /gil.t$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/ 'I said to them' will be evaluated in the next tableau:

(5.64)

ONS>>*LLL>> *3μ>>*[VP>>*CVV.CV]$_{\sigma}$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>>MAX-C>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/gil.t$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/	ONS	*LLL	*3μ	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ μ a. ˈgilt. li.hum						*!										*	***
μμμ μ μ b. ˈgi l t. li.hum			*!			*									*	*	***
μμ μ μ ☞ c. ˈgil.ti. hum														*	*		**

Candidate (c) is successfully identified as optimal since it has no violation of the *3μ and SYLLCON constraints. Candidate (a) avoids the violation of the *3μ constraint through more sharing but fails to satisfy the SYLLCON constraint due to rising sonority across a syllable boundary. The *3μ constraint is violated by candidate (b) where there is a non-final trimoraic syllable.

To conclude, the main question here has been "how are non-final superheavy syllables CVVC and CVCC avoided in NA?" I started with non-final CVV.C_{μ} in which the final consonant is a semisyllable. This semisyllable was affiliated to the preceding syllable which has a long vowel by mora sharing when associating with a consonant-initial affix (Broselow 1992, Watson 2007); e.g. /ga:.l_{μ}-ha_{OBJ}/→ [ga:l.ha_{OBJ}] 'he said it'. The same semisyllable is avoided when suffixing with a vowel-initial affix because this semisyllable is resyllabifed as an onset of the following syllable; e.g., /ga:.l_{μ}-u_{OBJ}/→ [ga:.lu_{OBJ}] 'they said'. If the non-final CVV.C_{μ} is associated with a dative plus a consonant-initial affix, then vowel epenthesis will be the solution uses to affiliate the first and second semisyllables to a syllable node where an epenthetic vowel is employed as its nucleus, whereas mora sharing is blocked; e.g., /ga:.l_{μ}-l_{μ}-hum_{OBJ}/→ [ga:.l**i̲**l.hum_{OBJ}] 'he said to them'. However, if the same syllable is suffixed with a dative plus vowel-initial affix, then mora sharing will be applied to avoid a trimoraic syllable while a dative will be resyllabified as an onset of the following syllable; /ʤa:.b_{μ}-l_{μ}-i_{OBJ}/→ [ʤa:b.li_{OBJ}] 'he brought to me. On the other hand, a non-final CVC.C_{μ} in which the final consonant is assigned as a semisyllable is avoided by vowel epenthesis when attaching to a consonant-initial affix; e.g., /bin.t_{μ}-ha_{OBJ}/→ [bin.t**i̲**.ha_{OBJ}] 'her daughter'. Also, when the same syllable is associated with a dative plus consonant-initial affix; e.g., /gil.t_{μ}.l_{μ}.hum_{OBJ}/→[gil.til.hum_{OBJ}] 'I said to them'. Likewise, the same syllable is avoided by vowel epenthesis when it is suffixed with a dative plus a vowel-initial affix; e.g., /gil.t_{μ}.l_{μ}-ah_{OBJ}/→[gil.ti.lah_{OBJ}] 'I said to him'. However, vowel epenthesis is blocked when the non-final CVCC is suffixed with a vowel-initial affix. Therefore, the last consonant of a non-final syllable will be resyllabified as an onset of the following syllable; e.g., /gilt-u_{OBJ}/→ [gil.tu_{OBJ}] 'you (pl.). The entire motivators for epenthesis were demonstrated and analysed using OT. In the next section, I illustrate vowel shortening in NA using OT.

5.4 Vowel Shortening

As discussed in section 3.3, vowel shortening in hollow verbs (verbs of the canonical shape CaaC) in some modern Arabic dialects has been reported by scholars in Arabic phonology including Harrama (1993), Al-Mohanna (1998), and Rakhieh (2009). They agree that this process has an impact on syllable structure as well as on vowel epenthesis, metathesis, and syncope (deletion) which will be addressed in the next section; i.e. /CVVC/→ [CVC]. In NA, long vowels in hollow verbs are targeted by vowel shortening when these verbs are associated with a consonant–initial subject agreement suffix. This statement is shown by the examples in (5.65) below:[51]

(5.65) a. /ga:.l_{μ}+t_{SUB}/→ [ˈg$i_{\mu}$$l_{\mu}$.t] ‘I said’

b. /ga:.l_{μ}+ti_{SUB}/ → [ˈg$i_{\mu}$$l_{\mu}$.$ti_{\mu}$] ‘you (f. sg.) said’

c. /ga:.l_{μ}+tu_{SUB}/ → [ˈg$i_{\mu}$$l_{\mu}$.$tu_{\mu}$] ‘you (pl.) said’

d. /ga:.l_{μ}+na_{SUB}/→ [ˈg$i_{\mu}$$l_{\mu}$.$na_{\mu}$] ‘we said’

e. /ʤa:.b_{μ}+t_{SUB}/ → [ˈʤ$i_{\mu}$$b_{\mu}$.t] ‘you (m. sg.) brought’

f. /ʤa:.b_{μ}+ti_{SUB}/→ [ˈʤ$i_{\mu}$$b_{\mu}$.$ti_{\mu}$] ‘you (f. sg.) brought’

g. /ʤa:.b_{μ}+tu_{SUB}/ → [ˈʤ$i_{\mu}$$b_{\mu}$.$tu_{\mu}$] ‘you brought’

h. /ʤa:.b_{μ}+na_{SUB}/→ [ˈʤ$i_{\mu}$$b_{\mu}$.$na_{\mu}$] ‘we brought’

i. /ra:.$ħ_{\mu}$+t_{SUB}/→ [ˈr$i_{\mu}$$ħ_{\mu}$.t] ‘you (m. sg.) went’

j. /ra:.$ħ_{\mu}$+ti_{SUB}/→ [ˈr$i_{\mu}$$ħ_{\mu}$.$ti_{\mu}$] ‘you (f.sg.) went’

k. /ra:.$ħ_{\mu}$+tu_{SUB}/→ [ˈr$i_{\mu}$$ħ_{\mu}$.$tu_{\mu}$] ‘you (pl.) went’

l. /ra:.$ħ_{\mu}$+na_{SUB}/→ [ˈr$i_{\mu}$$ħ_{\mu}$.$na_{\mu}$] ‘we went’

m. /ʃa:.l_{μ}+t_{SUB}/→ [ˈʃ$i_{\mu}$$l_{\mu}$.t] ‘you (m sg.) carried’

n. /ʃa:.l_{μ}+ti_{SUB}/→[ˈʃ$i_{\mu}$$l_{\mu}$.$ti_{\mu}$] ‘you (f. sg.) carried’

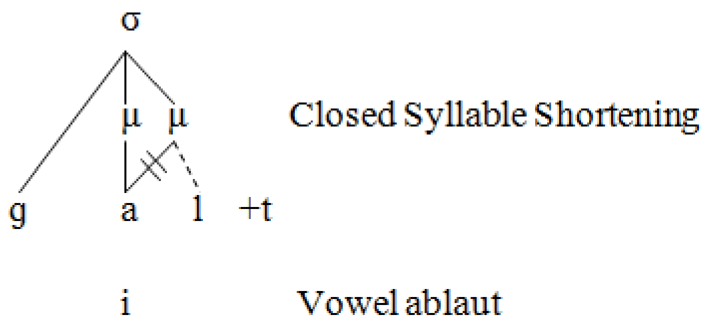
o. /ʃa:.l_{μ}+tu_{SUB}/→[ˈʃ$i_{\mu}$$l_{\mu}$.$tu_{\mu}$] ‘you (pl.) carried’

[51] Rakhieh (2009:248) introduces the *VVC constraint in order to ban a sequence like /VV.C_{μ}/ that results from the association of a hollow verb with a consonant-initial subject agreement suffix. This behaviour shows that mora sharing is blocked when a hollow verb is associated with a consonant-initial subject agreement suffix. Alternatively, vowel shortening is used to avoid a non-final superheavy syllable.
There is a vowel-initial subject agreement suffix /-it/ (f.sg.) is asscoiated with a hollow verb but it does not motivate vowel shortening because a semisyllable is resyllabified as the onset of the following syllable in order to avoid any onsetless syllable; e.g., /ga:.l_{μ} + it_{SUB}/→ [ga:.lit] ‘she said’

p. /ʃa:.l_μ+na_{SUB}/→[ˈʃ$i_\mu l_\mu$.na_μ] ‘we carried’

According to the examples in (5.65), long vowels in hollow verbs undergo vowel shortening since these verbs are suffixed with consonant–initial subject agreement suffixes. Subsequently stem vowel /a/ is changed to /i/. This process is known as vowel ablaut or alternation which occurs to change vowels in root or stem from CaC to CiC, according to Abboud (1979). Consider the representation of /ga:.l_μ+t/ below:[52]

(5.66)



The candidates of the input /ga:.l_μ+na_{SUB}/‘we said’ will be evaluated n the next tableau:

(5.67)

ONS>>*LLL>> *3μ>>*[VP>>*CVV.CV]$_\sigma$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ga:.l_μ+na_{SUB}/	ONS	*LLL	*3μ	*[VP	*CVV.CV]$_\sigma$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ a. ga:l.na			*!			*											*
μμ μ b. g i l. na						*					*	*					*
μ μ μ c. ga l.na						*					*	*					*

The optimal candidate of the input /ga:.l_μ+na_{SUB}/‘we said’ is not determined in the tableau (5.67) since candidates (b) and (c) equally violate constraints including SYLLCON, MAX-IO, MAX-μ-IO, and *CODA. Therefore, there must be a constraint

[52] The representation shape is taken from Watson’s book (2002:180).

that can discriminate between candidate (b) and (c) and determine candidate (b) as optimal. In section 3.3, I introduce a VOWEL ABLAUT (VA) constraint that can prevent candidate (c) from being optimal:

(5.68)

> VOWEL ABLAUT (VA)
> The shortened vowel that results from the attachment of a consonant-initial subject agreement suffix should undergo vowel ablaut (vowel alternation).

The constraint in (5.68) will be outranked by the SYLLCON, MAX-IO, MAX-μ-IO, and *CODA constraints in the following tableau in order to identify candidate (b) as optimal.

(5.69)

ONS>>*LLL>> *3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> MAX-C>> MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ga:.l$_{\mu}$+na$_{SUB}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ a. ga:l.na			*!				*											*
μμ μ ☞b. g i l. na							*					*	*					*
μ μ μ c. ga l.na				*!			*					*	*					*

Candidate (b) is successfully determined in the tableau (5.69) as optimal because it avoids the violation of the *3μ and VA constraints, compared to candidates (a) and (c). In candidate (a), there is a non-final trimoraic syllable which results in the violation of the *3μ constraint while the same constraint is avoided by candidate (c) through long vowel shortening but the shortened vowel does not undergo vowel ablaut. As a result, this candidate does not satisfy the VA constraint.

A long vowel /a:/ in hollow verbs CaaC in NA is targeted by vowel shortening when a hollow verb is associated with a dative plus a consonant-initial object suffix in order to avoid any unstressed heavy syllable. Consider the following examples:

(5.70)

a. /ˈga:.l$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/→ [ga$_{\mu}$.ˈl**i̲**$_{\mu}$l$_{\mu}$.hu$_{\mu}$m] ‘he said to them’

b. /ˈga:.l$_{\mu}$-l$_{\mu}$-na$_{OBJ}$/ → [ga$_{\mu}$.ˈl**i̲**$_{\mu}$l$_{\mu}$.na$_{\mu}$] ‘he said to us’

c. /ˈʤa:.b$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/ → [ʤa$_{\mu}$.ˈb**i̲**$_{\mu}$l$_{\mu}$.hu$_{\mu}$m] ‘he brought to them’

d. /ˈra:.ħ$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/→ [ra$_{\mu}$.ˈħ**i̲**$_{\mu}$l$_{\mu}$.hu$_{\mu}$m] ‘he went to them’

Any unstressed heavy syllable can be avoided by the following constraint:

(5.71)

WSP (Weight-to-Stress -Principle) (Kager 2010:155):
Heavy syllables are stressed.

The constraint in (5.71) will be outranked the MAX-C and MAX-IO constraints in order to eliminate any candidate with an unstressed heavy syllable. In the next tableau, I will evaluate the candidates of the input /ra:.ħ$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/ ‘he went to them’:

(5.72)

ONS>>*LLL>> *3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> WSP>>MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ra:.ħ$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	WSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ μ a. ˈra:.ħ.li.hum			*!				*												**
μμ μμ μ b. ra:.ˈħil.hum											*!					*	*		**
μ μμ μ ☞c. ra.ˈħil.hum													*	*		*	*		**

The tableau (5.72) identifies candidate (c) as optimal since it satisfies the *3μ and WSP constraints. Candidate (a) cannot be optimal because it has a non-final trimoraic syllable that violates the *3μ constraint. Candidate (b) avoids the violation of the same constraint by inserting an epenthetic vowel after the first semisyllable in order to achieve a syllable where semisyllables have been affiliated to but it fails to comply with the WSP constraint due to a non-final unstressed heavy syllable. As a result, this candidate fails to be optimal.

Vowel shortening not only targets a long vowel /a:/ in hollow verbs in NA but it targets a long vowel /a:/ in nouns in order to avoid an unstressed heavy syllable of the form CVV that results from the deletion of a final glottal stop in some adjectives. Consider the following examples:

(5.73)

a. /ˈħam.ˈra:ʔ/→ /ˈħam.ra:/→ [ˈħam.ra] ‘red (fm. sg.)’

b. /ˈsˤaf.ˈra:ʔ/→ /ˈsˤaf.ra:/→ [ˈsˤaf.ra] ‘yellow (fm. sg.)’

c. /ˈʕam.ˈja:ʔ/→ /ˈʕam. ja:/→ [ˈʕam.ja] ‘blind (fm.sg.)’

In the next tableau, I will evaluate the candidates of the input /ħam.ra:ʔ/ ‘red (fm. sg.)’:

(5.74)

ONS>>*LLL>> *3μ>>VA>>*[VP>>*CVV.CV]$_σ$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> WSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈħam.ˈra:ʔ/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	WSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μμ a. ˈħam. r a:ʔ							*				*!								**
μ μ μμ ☹ b. ˈħam.ˈr a:ʔ							*												**
μ μ μ c. ˈħam.r a							*					*!	**	*					*
μ μ μμ d. ˈħam.r a:							*				*!	*	*						*

The tableau (5.74) selects candidate (b) as optimal because it has no violation of the WSP and MAX-IO constraints. Candidates (a) and (d) fail to avoid the violation of the WSP constraint since they have unstressed heavy syllables while candidate (c), as a desired output, complies with this constraint (WSP) through a long vowel shortening but this candidate fails to satisfy the MAX-C constraint. As a result, this candidate cannot be optimal. Looking at candidate (b), there are two adjacent stressed syllables that distinguish this candidate from other candidates. Accordingly, this candidate can be eliminated by a constraint that disfavours stress clash:

(5.75)

*CLASH (Kager 1999):
No adjacent syllables are stressed.

The constraint in (5.75) will be outranked by WSP and MAX-IO in order to determine candidate (c) as optimal. Consider the following tableau:

(5.76)

ONS>>*LLL>> *3μ>>VA>>*[VP>>*CVV.CV]$_σ$ >> SYLLCON>>*LENITION-GUTTURAL>> LINEARITY>>SSP>> *CLASH >>WSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈħam.ˈra:ʔ/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μμ a. ˈħam. r a:ʔ							*					*!								**
μ μ μμ b. ˈħam.ˈr a:ʔ							*				*!									**
μ μ μ ☞ c. ˈħam.r a							*						*	**	*					*
μ μ μμ d. ˈħam.r a:							*					*!		*						*

Candidate (c) becomes optimal due to the satisfaction of the *CLASH and WSP constraints which are violated by the rest of the candidates. The WSP constraint is violated by candidates (a) and (d) while the adjacent stressed heavy syllables in candidate (b) result in the avoidance of the violation of WSP constraint. However, due to adjacent stressed syllables, candidate (b) fails to avoid the violation of *CLASH constraint. This behaviour is considered to be another motivator for vowel shortening in nouns in NA that targets a long vowel in a stressed heavy open syllable of the form CVV which is adjacent to another stressed heavy syllable. Consider the following examples:[53]

(5.77)

a. /ˈba:.ˈbi:n/→ [ba.ˈbi:n] ‘two doors’

b. /ˈʃa:.ˈriʕ.ha$_{OBJ}$/→ [ʃa.ˈriʕ.ha$_{OBJ}$] ‘her street’

[53] Note that stressed syllables are in bold.

In the next tableau, the following constraints are used to evaluate use to evaluate the candidate analyses of the input /ˈʃa:.ˈriʕ.ha$_{OBJ}$/ ‘her street’:

(5.78)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_σ$>>SYLLCON>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH >>WSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈʃa:.ˈriʕ.ha$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μμ μ a. ʃa:.ˈriʕ. ha												*!								*
μ μμ μ ☞ b. ʃa.ˈri ʕ.ha														*	*					*
μμ μ μ μ c. ˈʃa:.ˈr i ʕ. ha											*!									*

Output (b) is identified as the optimal candidate because it has no violation of the constraints *CLASH and WSP. In other words, this output permits vowel shortening in order not to have adjacent stressed syllables which, otherwise, violate *CLASH and not to have an unstressed heavy syllable which otherwise violates WSP. Output (c) preserves a long vowel in the antepenultimate syllable which is stressed along with the penultimate syllable, according to the stress parameters in NA identified in section 4.7. Thus, this output fails to satisfy *CLASH. Output (a) satisfies *CLASH by not having two adjacent stressed syllables but it cannot be optimal because it has an unstressed heavy syllable that violates the WSP constraint.

To conclude, in this section, vowel shortening was demonstrated as a factor that has an impact on syllable structure in NA. I also showed the three motivators for this phonological process. In other words, the question related to the motivating factors of vowel shortening in NA has been addressed in this section. The first factor is related to the association of a hollow verb of the form CaaC with a consonant-initial subject agreement suffix. The second factor is the avoidance of an unstressed heavy syllable which results from the association of a hollow verb with the dative and consonant-inittial suffix. In nouns, a long vowel in an unstressed heavy syllable which results from the deletion of a final glottal stop undergoes vowel shortening in order to comply with the WSP constraint. The final motivating factor is stress clash which prominently results from having two stressed syllables adjacent to each other; vowel shortening targets a long vowel in a stressed heavy syllable of the form CVV. OT accounts for this behaviour using the *CLASH constraint that militates against any candidate with adjacent heavy stressed syllables. In the next section, I will examine the impact of syncope on syllable structure in NA.

5.5 Syncope

As discussed in section 3.4, Syncope was described by scholars including Al-Mozainy (1981), Irshied (1984), Harrama (1993), Al-Mohanna (1994, 1998), Ingham (1994), Sakarna (1999,2005), Rose (2000),Watson (2002),and Rakhieh (2009), as a phonological process that has an impact on the syllable structure. Most, such as Al-Mozainy (1981), Irshied (1984), Harrama (1993), Sakarna (1999), Watson (2002), and Rakhieh (2009) agree that unstressed short vowels in non-final light syllables are targeted by deletion which results in initial bi-consonantal clusters. The three light syllables that result from the association of the form CV.CVC with a vowel-initial suffix is not preferable in NA. As a result, the short vowel of the light antepeultimate syllable is targeted by syncope in order to achieve the output [ˈCCV.CV]. This process is known as a trisyllabic elision as shown in (5.79):

(5.79)

(I) a. /ˈra.kab-u$_{OBJ}$/ → /ˈ**ra**.ka.bu/→ [ˈrki.bu] ‘they rode’

b. /ˈka.tab-at$_{OBJ}$/ → /ˈ**ka**.ta.bu/→ [ˈkti.bat.] ‘she wrote’

c. /ˈra.sam-at$_{OBJ}$/→ /ˈ**ra**.sa.mat/→ [ˈrsi.mat.] ‘she drew.

d. /ˈra.sam-u$_{OBJ}$/ → /ˈ**ra**.sa.mu/→ [ˈrsi.mu.] ‘they drew’

e. /ˈsa.rag-u$_{OBJ}$/ → /ˈ**sa**.ra.gu/→ [ˈsri. gu.] ‘they stole’

f. /ˈdʒa.las-at$_{OBJ}$/ → /ˈ**dʒa**.la.sat/→ [ˈdʒli.sat.] ‘she sat’

(II) a. /ˈka.sar-u$_{OBJ}$/ →/ˈ**ka**.sa.ru/→ [ˈksa.rau] ‘they broke’

b. /ˈχa.daʕ-u$_{OBJ}$/→/ˈ**χa**.da.ʕu/→ [ˈχda.ʕu] ‘they deceived’

c. /ˈʃa.raħ-u$_{OBJ}$/→ /ˈ**ʃa**.ra.ħu/→ [ˈʃra.ħu] ‘they explained’

d. /ˈwa.zin-u$_{OBJ}$/ → /**ˈwa**.zi.nu]→ [wza.nu] ‘they measured weight’

e. /ˈχa.ðal-at$_{OBJ}$/ → /ˈ**χa**.ða.lat/→ [ˈχða.lat.] ‘she betrayed’

The verbs in (5.79) are of the binyan form (I), i.e. /faʕal/. These verbs are associated with vowel-initial suffixes which result in three light syllables. The short vowel in a light antepenultimate in (5.79-I, II) undergoes syncope since it is adjacent to a light penultimate syllable that results from the association of the form CV.CVC with a vowel-initial suffix, i.e. trisyllabic elision. Word-initial clusters are created by the syncope of short vowels in the light antepenultimate syllables. In (5.79-I), short low vowels in the penultimate syllables in the outputs undergo vowel raising because they are flanked by non-gutturals. Also, these vowels are not followed by the sonorants [l, n, r, w]. As discussed in section 1.4, vowel raising is not blocked when a low vowel /a/ is not flanked by gutturals or is followed by sonorants [r, l, n, w]. In (5.79-II), the raising of the low vowel /a/ in the penultimate syllables in outputs is blocked because it is followed by gutturals or sonorants [r, l, n]. For instance, in the outputs in (a), (d), and (e), a low vowel /a/ in the penultimate syllable is followed by sonorants. Therefore, this vowel is not targeted by vowel raising. Similarly, in the outputs (b) and (c), a low vowel /a/ in the penultimate syllable is not undergone vowel raising since it is followed by gutturals /ħ/ and /ʕ/.

Three light syllables in NA also result from the association of nouns of the form CV.CVC with vowel-initial possessive (POSS) suffixes. Consider the following examples:

(5.80)

a. /ˈba.gar-ak$_{\text{POSS}}$/→/ˈ**<u>ba</u>**.ga.rak/→ [ˈbga.rak] ‘your cows’

b. /ˈʃa.ʤar-ah$_{\text{POSS}}$/ →/ˈ**<u>ʃa</u>**.ʤa.rah/ → [ˈʃʤa.rah] ‘his tree’

c. /ˈga.raʕ-ah$_{\text{POSS}}$/ →/ˈ**<u>ga</u>**.ra.ʕah/ → [gra.ʕah] ‘his melon’

In (5.80), the three light syllables result from the association of nouns of the form CV.CVC with a vowel-initial possessive suffix. A light antepenultimate syllable that is adjacent to a light penultimate syllable is not immune to syncope in order to reduce the number of light syllables. This type of deletion is particular to a trisyllabic elision that is reported by Al-Mozainy (1981), Irshied (1984), Sakarna (1999, 2005) and Rakhieh (2009), as mentioned in section 3.4.

An unstressed short vowel in a non-final light syllable is deleted when it is followed by a syllable of the form CVVC as shown in (5.81).

(5.81)

a. /b**u̲**.ˈsˤa:tˤ/ →	[ˈbsˤa:tˤ]	‘carpet’
b. /t**u̲**.ˈfu:ħ/ →	[ˈtfu:ħ]	‘you (m) boil/ she boils’
c. /t**u̲**.ˈθu:r/ →	[ˈtθu:r]	‘you (m) rage/she rages’
d. /t**u̲**.ˈsˤu:m/→	[ˈtsˤu:m]	‘you (m) fast/ she fasts’
e. /t**u̲**.ˈlu:m/→	[ˈtlu:m]	‘you blame or he/she blames’
f. /t**u̲**.ˈra:b/ →	[ˈtra:b]	‘sand’
g. /d**u̲**.ˈmu:ʕ/ →	[ˈdmu:ʕ]	‘tears’
h. /ð**i̲**.ˈra:ʕ/	[ˈðra:ʕ]	‘arm’

Unstressed short vowels in non-final light syllables in NA are targeted by syncope when these syllables are followed by syllables of the forms CVVC. As seen in section 3.4, this phenomenon is observed in several dialects like BHA (Al-Mozainy 1981), the Al-Jabal dialect in Libya (Harrama 1993), and San'ani Arabic (Watson 2002). Likewise, an unstressed short vowel in the antepenultimate syllable in NA undergoes syncope when this syllable is followed by a stressed heavy syllable that includes the first half of a geminate or a stressed syllable of the form CVV. Consider the following examples:

(5.82)	a. /z**i̲**.ˈra:.ʕah/→	[ˈzra:.ʕah]	‘agriculture’
	b. /t**i̲**.ʁa:.mir/ →	[tʁa:.mir]	‘you (m) take risks’
	c. /t**i̲**.maθ.θil/ →	[tmaθ.θil]	‘you act or he /she acts’

According to the examples in (5.82), the underlying forms show light antepenultimate syllables being unstressed when these syllables are adjacent to heavy penultimate syllables. The unstressed short vowels in these light antepenultimate syllables undergo syncope in the surface form. This behaviour in NA is similar to that found in the Al-Jabal dialect (Harrama 1993) and San’ani Arabic (Watson 2002), as illustrated in section 3.4; Harrama (1993) notes that an initial consonant cluster is created by the deletion of the underlying unstressed short vowel in the light antepenultimate syllable that is followed by the stressed heavy penultimate syllable; e.g., /n**i̲**gád.dim/→

[ngád.dim] ‘I offer’. Watson (2002) reports that initial consonant clusters in San'ani Arabic are also created by the deletion of unstressed short vowels in light antepenultimate syllables; e.g., /f**i**.him.tii/ → [**fh**im.tii] ‘you (fm. sg.) understood’, and /n**i**.χaz.zin/→ [**nχ**az.zin] ‘we store’.

However, an unstressed short vowel in a light penultimate syllable that results from the association of the form CVC.CVC with a vowel-initial suffix is not targeted by syncope in order not to have a non-final CVCC in NA. Consider the following examples:

(5.83) a. /ˈjak.tib-ah$_{OBJ}$/ [ˈjak.t**i**.bah] /*[ˈjakt.bah] ‘he writes it (m. sg.)’

b. /ˈtak.tib-ah$_{OBJ}$/ [tak.t**i**.bah] /*[ˈtakt.bah] ‘she writes it (m. sg.)’

c. /ˈtar.sim-ah$_{OBJ}$/ [ˈtar.s**i**.mah]/* [tars.mah] ‘she draws it (m.sg.)’

d. /ˈjar.sim-ah$_{OBJ}$/ [ˈjar. s**i**.mah] / *[ˈjars.mah] ‘he draws it (m.sg.)’

Unstressed short vowels in light penultimate syllables which are formed by the association of phonological words with vowel-initial affixes are not targeted by syncope in order to avoid non-final CVCC in NA; i.e. non-final trimoraic syllables are disfavoured in NA. Also, no mora sharing is applied to the case where there is a non-final CVCC, compared to non-final CVVC. This behaviour is also found in BHA (Al-Mozainy 1981), TA (Al-Mohanna 1994), and UHA (Al-Mohanna 1998) (see section 3.4). According to Al-Mozainy (1981), syncope is blocked if it results in non-final CVCC. Therefore, an unstressed short vowel in a light penultimate syllable is preserved in BHA; e.g., /yiʃ.rik-uun/→ [jiʃ.ri.ku:n] /* [jiʃr.ku:n] ‘they become non-believers’, and /jisrig-uun/→ [jis.ri.guun] /*[jisr.gu:n] ‘they steal’. According to Al-Mohanna (1998), an unstressed short vowel in a light penultimate syllable that is created by suffixing a phonological word with a vowel-initial affix does not undergo syncope in order to avoid non-final CVCC syllable in UHA; e.g., /jiħ.rig-u/→[jiħ.ri.gu.] / *[jiħr.gu] ‘they burn’.

Syncope in NA never occurs in the case where the verb form ˈCV.CVC is associated with a consonant-initial object suffix. A non-final syllable is light and stressed while the final syllable is light and unstressed because the last consonant is assigned as extrametrical, see section 4.7; i.e. /ˈCV.CV<C>/. Consider the following examples:

(5.84) a. /ˈri.kab-na$_{OBJ}$/ [ri.ˈkab.na$_{OBJ}$] ‘We rode’

b. /ˈki.tab-tu$_{OBJ}$/ [ki.ˈtab.tu$_{OBJ}$] ‘You (pl.) wrote’

c. /ˈχa.ðal-na$_{OBJ}$ / [χa.ˈðal.na$_{OBJ}$] ‘We betrayed’

d. /ˈsi.maʕ-na$_{OBJ}$/ [si.ˈmaʕ.na$_{OBJ}$] ‘We heard’

e. /ˈdʒa.las-na$_{OBJ}$/ [dʒa.ˈlas.na$_{OBJ}$] ‘We sat’

f. /ˈri.sam-na$_{OBJ}$/ [ri.ˈsam.na$_{OBJ}$] ‘We drew’

g. /ˈsa.rag-na$_{OBJ}$/ [sa.ˈrag.na$_{OBJ}$] ‘We stole’

h. /ˈʔa.kal-na$_{OBJ}$/ [ʔa.ˈkal.na$_{OBJ}$] ‘We ate’

Unlike the examples in (5.79) and (5.80), the association of verbs of the form CV.CVC with a consonant-initial suffix never results in three light syllables, as in examples in (5.85). Also, short vowels in non-final light syllables in the underlying forms are not unstressed, compared to unstressed short vowels in non-final light syllables in the examples in (5.81), (5.82), and (5.83). The examples in (5.84), show that the non-final syllable in the verb form ˈCV.CVC is stressed and the final syllable is light and unstressed due to the extrametricality assignment of the last consonant; i.e. the last consonant complies with the peripherality condition as discussed in subsection 2.5.1 and section 4.7. When this form is associated with a consonant-initial affix, a certain resyllabification occurs; the final CVC is preceded by a consonant-initial affix and becomes a heavy penultimate syllable. As a result, stress shifts to a heavy penultimate syllable rather than being received by a light antepenultimate syllable; i.e., /ˈCV.CV<C>/ → the attachment of a consonant-initial object suffix /-CV/→ stress shifts to a heavy penultimate syllable→ [CV.ˈCVC.CV]. Although stress is no longer received by a light antepenultimate in the surface, an unstressed short vowel in this syllable does not undergo syncope.

There is another exceptional case in NA where unstressed short vowels are immune to syncope even though they are in an appropriate environment for syncopy as in (5.85):

(5.85)

(I) a. /mu.ˈdi:r/ [m**u**.di:r] /*[ˈmdi:r] ‘manager’

b. /χu.ˈsˤu:m/ [χ**u**.ˈsˤu:m] /*[ˈχsˤu:m] ‘opponents’

c. /sa.ˈla:m/ [sa.ˈla:m] /*[ˈsla:m] ‘peace’

(II) a. /ħa.ˈwa:.mil/ [ħ**a**.ˈwa:.mil]/*[ˈħwa:.mil] ‘pregnant’

(III) a. /ˈma.lik-i$_{\mathrm{POSS}}$/ [ˈma.l**i**.ki] /*[ˈmla.ki] ‘my king’

b. /ˈma.lik-ah$_{\mathrm{POSS}}$/ [ˈma.l**i**.kah] / *[ˈmla.kah] ‘queen’

The short vowels in non-final light syllables are in environments where they can be targeted by syncope. For instance, in (5.85-I), unstressed short vowels are in non-final light syllables that are followed by stressed syllables of the form CVVC in the underlying forms. In (5.85-II), unstressed short vowels in light antepenultimate syllables in the underlying forms are followed by heavy syllables. The three light syllables in (5.85-III) that result from the association of the form ˈCV.CVC with a vowel-initial possessive suffix are not reduced by the syncope of short vowels in the light antepenultimate syllables that are adjacent to light penultimate syllables, i.e. trisyllabic elision. All short vowels in non-final syllables in (5.85) are immune to syncope because they are in words borrowed from SA. In other words, these words are governed by the phonology of SA, not the phonology of NA, and this is why syncope is blocked.

The syncope results from the association of a word with a vowel-initial affix will be accounted for using OT. The following constraints will be used in the next tableau to evaluate the candidates of the input /s**a**rag-u$_{\mathrm{OBJ}}$/ ‘they stole’:

(5.86)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH >>WSP>> MAX-C>>MAX-IO>> MAX-μ-IO>> *COMPLEX$_{ONS}$ >> O-CONTIG >>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈsa.rag-u$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈsa.ra.gu		*!																		
μ μ b. ˈsri.gu														*	*	*				
μ μ c. ˈsru.gu														*	*	*				
μ μ d. ˈsra.gu														*	*	*				

The tableau (5.86) could not determine the optimal candidate since candidates (b), (c), and (d) equally violate the MAX-IO, MAX-μ-IO, and *COMPLEX$_{ONS}$ constraints. Therefore, it is very important to add some constraints that can eliminate candidates (c) and (d) and distinguish (b) as optimal; this can be done by using the following constraints:

(5.87)

a. No [a] (Orgun 1995)
/a/ is not allowed in light syllables.

b. No [u]
/u/ is not allowed in light syllables.

The constraints will outrank MAX-IO in order to determine candidate (b) as optimal. Consider the following tableau:

(5.88)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH >>WSP>>MAX-C>> No[u]>> No[a]>> MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO>>*COMPLEX$_{CODA}$ >>*CODA

/ˈsa.rag-u$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈsa.ra.gu		*!												*	**							
μ μ ☞ b. ˈsri.gu														*		*	*	*				
μ μ c. ˈsru.gu														**!		*	*	*				
μ μ d. ˈsra.gu														*	*!	*	*	*				

Candidate (b) is selected as optimal because it avoids the violation of the *LLL and No [a] constraints and assigns one violation mark of the No [u] constraint. The three light syllables in candidate (a) results in the violation of the *LLL constraint. Therefore, this candidate fails to be optimal. Candidate (c) avoids the violation of the same constraint but violates the No [u] twice. The violation of the *LLL constraint is also avoided by candidate (d) but this candidate fails to satisfy the No [a] constraint. As a result, this candidate is eliminated from being optimal. The candidates of the input /ˈʃa.ʤar-ah$_{POSS}$/ will be evaluated in the next tableau:

(5.89)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_σ$>>SYLLCON>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH >>WSP>>MAX-C >>No[u]>> No[a] >>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO>>*COMPLEX$_{CODA}$ >>*CODA

/ˈʃa.ʤa.ra/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈʃa. ʤa.ra		*!													***							*
μ μ ☞b. ˈʃʤa.ra															**	*	*	*				*
μ μ μ c.ˈʃaʤ.ra							*!								*	*	*					**

The tableau above successfully identifies output (b) as an optimal candidate. This output avoids the violation of the *LLL and SYLCON constraints. Output (a) fails to be identified as optimal becausese it has three light syllables that violate the *LLL constraint. Output (c) avoids the violation of the *LLL constraint by the deletion of an unstressed short vowel in a light penultimate syllable but this deletion results in rising sonority across a syllable boundary which does not comply with the SYLLCON constraint. Is it possible to select the output [zraa.ʕah] as the optimal candidate analysis of the input /zi.ra:.ʕah / 'agriculture' using the same set of constraints? To answer this question, the next tableau will show the analysis of the outputs of /zi.ˈra:.ʕah/.

(5.90)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_σ$>>SYLLCON>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH >> WSP >>MAX-C>>No[u]>> No[a]>>MAX-C>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO>>*COMPLEX$_{CODA}$ >>*CODA

/zi.ˈra:.ʕah/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ μ ☹a.zi.ˈra:.ʕah															*							*
μμ μ b. ˈzra:.ʕah															*	*!	*	*				*
μ μμ μ c. za.ˈra:.ʕah															**!	*	*					*
μ μμ μ d. zu.ˈra:.ʕah														*!	*							*

Candidate (a), as a wrong output, is selected as optimal because it avoids the violation of most highly-ranked constraints and it has one violation of the No [a] constraint. Candidate (b), as a desired output, is eliminated from being optimal by the violation of the MAX-IO constraint. The two violations of the No[a] constraint by candidate (c) prevent this candidate from being optimal. Candidate (d) fails to be optimal due to the violation of the No[u] constraint. In order to determine candidate (b) as optimal, there must be a constraint that disfavours unstressed high short vowels in light syllables as follows:

(5.91) *i]$_σ$ (Kenstowicz 1996)

High short unstressed vowels in open syllables are not allowed.

The constraint above will be added to the set of constraints in the next tableau and it will be ranked higher than the MAX-IO constraint.

(5.92)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*CLASH >>WSP>>MAX-C>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO>> *COMPLEX$_{CODA}$ >> *CODA

/zi.ˈra:.ʕah/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ μ a.zi.ˈra:.ʕah								*!								*							*
μμ μ ☞b. ˈzra:.ʕah																*	*	*	*				*
μ μμ μ c. za.ˈra:.ʕah																**!	*	*					*
μ μμ μ d. zu.ˈra:.ʕah								*!							*	*							*

The *i]$_{\sigma}$ constraint in the tableau above helps output (b), as a desired output, to be distinguished as the optimal candidate of the input /zi.ˈra:.ʕah / ‘agriculture’. This constraint, however, is violated by output (a) and (d) because these outputs have unstressed high short vowels in open syllables. Candidate (c) cannot be optimal because it violates No [a] constraint twice. The set of constraints in (5.93) will be used to evaluate the candidate analyses of the input /t**i̱**.ˈmaθ.θil/ ‘you act or he /she acts’ in the next tableau:

(5.93)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_\sigma$>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH >>WSP>>MAX-C>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO>>*COMPLEX$_{CODA}$ >>*CODA

/ti.ˈmaθ.θil/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ μ a. ti.ˈmaθ. θil								*!															**
μ μμ μ b. tu.ˈmaθ. θil								*!							*								**
μ μμ μ c. ta.ˈmaθ. θil																*!							**
μμ μ ☞d. ˈtmaθ.θil																	*	*	*				**

The tableau above identifies output (d) as the optimal candidate of the input /ti.ˈmaθ.θil/ since it avoids the violation of the constraints including *i]$_\sigma$, No[u], and No[a]. Candidates (a), (b), and (c) violate these constraints; candidates (a) and (b) do not comply with the *i]$_\sigma$ constraint while candidate (c) satisfies this constraint by not having a high short unstressed vowel in open syllables. However, an unstressed low vowel [a] in a non-final light syllable in this candidate results in the violation of the No[a] constraint. In the next tableau, I will evaluate the candidates of the input /ði.ˈra:ʕ/ ‘an arm’:

(5.94)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_\sigma$>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*CLASH >>WSP>>MAX-C>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$ >>*CODA

/ði.ˈra:ʕ/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ a. ði.ˈra:ʕ								*!															*
μμ ☞b.ˈðra:ʕ																	*	*	*				*

The tableau above identifies output (b) as the optimal candidate of the input /ði.ra:ʕ/ because it has no violation of the *i]$_\sigma$ constraint while this constraint is violated due to an unstressed high short vowel in a non-final open light syllable. In the next section, I will show how the set of constraints in (5.95) is applicable to the syllable structure processes in this chapter.

5.6 The unified set of OT constraints

This section aims to show how a set of constraints in (6.95) works with the previous data shown in the syllable structure processes; i.e. metathesis, epenthesis (initial and internal epenthesis), vowel shortening, and syncope. In other words, the question related to the insights about syllable structure processes that can be gained through OT is answered in this section. Consider the following tableau:

(5.95)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_\sigma$>>SYLLCON>>*i]$_\sigma$>>*LENITION-GUTTURAL>>LINEARITY>>SSP >> *CLASH >>WSP>>MAX-C>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$ >> *CODA

/ˈgah.wa/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈgah.wa							*!									*							*
☞b. ˈgha.wa										*	*					**			*				
c. ˈga.h**a**.wa		*!														***					*		
d. ˈgaw.wa									*!							*							*

/ˈnaχ.lah/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	SYLLCON	*i]$_\sigma$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈnaχ.lah							*!									*							**
☞b. ˈnχa.lah										*	*					**			*				*
c. ˈna.χ**a**.lah		*!														***					*		*
d. ˈnal.lah									*!							*							**

/ˈkti.ʃaf/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈkti.ʃaf					*!						*					*			*				*
☞b. ˈʔik.ti.ʃaf								*								*					**		**
c. ˈki.ti.ʃaf		*!						*								*				*	*		*
d. ˈik.ti.ʃaf	*!							*								*					*		**

/ˈskin/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈskin											*!								*				*
☞b. ˈʔis.kin																					**		**
c. ˈsi.kin																				*!			*
d. ˈis.kin	*!																				*		**

/ˈti.da.ris/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈtda.ris																*	*	*	*!				*
b. ˈdda.ris											*!					*	*	*	*				*
☞c. ˈʔid.da.ris																*	*	*			**		**
d. ˈti.da.ris		*!														*				*	*		*

/ˈsˁabr/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈsˁabr											*!											*	**
☞b. ˈsˁa.bur																*				*	*		*
c. ˈsˁab.ri							*!	*													*		*
d. ˈsˁab														*!			*						*

/ˈgarʃ/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a. ˈgarʃ																						*	**
b.ˈ ga.r**a**ʃ																				*!	*		*
c. ˈ gar.ʃ**i**							*!																*
d. ˈ gar														*!			*						*

/ˈbeː.t$_μ$-ha$_{POSS}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ ☞a. ˈbeːt. ha							*									*							**
μμ μ μ b. ˈbeː. t. ha			*!				*									*							**
μμ μ μ c .ˈbeː. t**i**. ha						*!										*					*		
μμ μ d. ˈbet. ha							*									*	*!	*					*

/bint-na$_{POSS}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ a. ˈbint.na							*!									*						*	**
μμμ μ b. ˈbint. na			*!													*						*	**
μμ μ μ ☞c.ˈbin.ti. na								*								*					*		*
μ μμ μ d. ˈbi.nit. na							*!	*								*				*	*		*

/ʤa:.b$_{\mu}$.l$_{\mu}$-ha$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ μ ☞a. ʤa.ˈbil. ha																**	*	*		*	*		*
μμ μ μ b. ˈʤa:b.li.ha							*!	*								*					*		*
μμ μ μ μ c. ˈʤa:.ba.la.ha		*!														***					**		

/ˈʤa:.b$_{\mu}$.l$_{\mu}$-i$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ ☞a. ˈʤa:b.li							*	*								*						*	*
μμμ μ b. ˈʤa:b.li			*!				*	*								*						*	*
μμ μ μ c. ˈʤa:.ba.li						*!		*								*					*		
μμ μ d. ˈʤab.li							*	*								*	*!	*					*

/gil.t$_{\mu}$-l$_{\mu}$-i$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ a. gilt. li							*!	*														*	***
μμμ μ b. ˈgilt. li			*!				*	*														*	***
μμ μ μ ☞ c. ˈgil.ti. li								**													*		**
μ μμ μ d. gi.ˈlit. li							*!	**												*	*		*

/gil.t$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μ μ a. ˈgilt. li.hum							*!	*							*							*	**
μμμ μ μ b. ˈgi l t. li.hum			*!				*	*							*							*	***
μμ μ μ ☞ c. ˈgil.ti. hum								*					*		*					*	*		***

/ga:.l$_{\mu}$+na$_{SUB}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ a. ga:l.na			*!				*									*							*
μμ μ ☞ b. g i l. na							*									*	*	*					*
μ μ μ c. ga l.na				*!			*									*	*	*					*

/ra:.ħ$_{\mu}$-l$_{\mu}$- hum$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμμ μ μ a. ˈra:.ħ.li.hum			*!																				**
μμ μμ μ b. ra:.ˈħil.hum													*!										**
μ μμ μ ☞c. ra.ˈħil.hum																*	*	*		*	*		**

/ˈħam.ˈraːʔ/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]σ	SYLLCON	*i]σ	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μμ a. ˈħam. r aːʔ							*						*!										**
μ μ μμ b. ˈħam.ˈr aːʔ							*					*!											**
μ μ μ ☞ c. ˈħam.r a							*							*		*	**	*					*
μ μ μμ d. ˈħam.r aː							*						*!	*			*	*					*

/ˈʃaː.ˈriʕ.ha$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]σ	SYLLCON	*i]σ	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μμ μμ μ a. ʃaː.ˈriʕ. ha													*!										*
μ μμ μ ☞ b. ʃa.ˈri ʕ.ha																**	*	*					*
μμ μ μ μ c. ˈʃaː.ˈr i ʕ. ha												*!											*

/ˈsa.rag-u$_{OBJ}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]σ	SYLLCON	*i]σ	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈsa.ra.gu		*!						*							*	**							
μ μ ☞ b. ˈsri.gu								*							*		*	*	*				
μ μ c. ˈsru.gu								*							**!		*	*	*				
μ μ d. ˈsra.gu								*							*	*!	*	*	*				

/ˈʃa.ʤa.ra/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μ μ a. ˈʃa. ʤa.ra		*!														***							*
μ μ ☞b. ˈʃʤa.ra																**	*	*	*				*
μ μ μ c.ˈʃaʤ.ra							*!									*	*	*					**

/zi.ˈraː.ʕah/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ μ a.zi.ˈraː.ʕah								*!								*							*
μμ μ ☞b. ˈzraː.ʕah																*	*	*	*				*
μ μμ μ c. za.ˈraː.ʕah																**!							*
μ μμ μ d. zu.ˈraː.ʕah								*!							*	*							*

/ti.ˈmaθ.θil/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
μ μμ μ a. ti.ˈmaθ. θil								*!															**
μ μμ μ b. tu.ˈmaθ. θil								*!							*								**
μ μμ μ c. ta.ˈmaθ. θil																*!							**
μμ μ ☞d. ˈtmaθ.θil																	*	*	*				**

/ði.ˈra:ʕ/	ONS	*LLL	*3μ	VA	*[VP	$*CVV.CV]_{\sigma}$	SYLLCON	$*i]_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	$*COMPLEX_{ONS}$	O-CONTIG	DEP-IO	$*COMPLEX_{CODA}$	*CODA
μ μμ a. ði.ˈra:ʕ								*!															*
μμ ☞b.ˈðra:ʕ																	*	*	*				*

The unified set of constraints in tableaux (5.95) shows how OT can be used to analyse the NA syllable structure processes, i.e. CV metathesis, vowel epenthesis, vowel shortening, and syncope. In other words, in this section, insights about NA syllable structure processes can be gained through the unified set of constraints in (5.97). In the CV metathesis section, this set of constraints determined the outputs [ˈɡha.wa] and [ˈnχa.lah] as optimal candidates of the input /ˈgah.wa/ ‘coffee’ and /ˈnaχ.lah/ ‘palm tree’. In the initial epenthesis section, the outputs [ˈʔik.ti.ʃaf], [ˈʔis.kin] and [ˈʔid.da.ris] are selected by the unified set of constraints in (5.95) as optimal candidates of the input /ˈkti.ʃaf/ ‘he discovered’, /ˈskin/ ‘dwell! (m.s.)’, and /ˈti.da.ris/ ‘you (m.s.) teach’. The internal epenthesis in NA was investigated through OT; sonority violation as a motivator for internal epenthesis was analysed by OT. One of the tableaux in (5.95) identifies output [sˤa.b**u̲**r] as optimal of the input /sˤabr/ ‘patience’; the SSP constraint militates against any candidate with sonority violation. Also, the SYLLCON constraint is used to avoid rising sonority across a syllable boundary. The case where consonant clusters obey the SSP is analysed using OT. The output [ˈgarʃ] is assinged as the optimal candidate of the input /ˈgarʃ/ ‘coin’. Non-final superheavy syllables that result in vowel epenthesis are accounted for using OT in the tableaux (5.95). The unified set of constraints above determines the output [be:$^{\mu\mu}$tha] as the optimal candidate of the input /be:t-ha$_{POSS}$/ ‘her house’. The outputs [ˈbin.t**i̲**.na], [ʤa.ˈb**i̲**l.ha], [ˈʤa:$^{\mu\mu}$b.li], [ˈgil.t**i̲**.lah], and [gil.ˈt**i̲**l.hum] were identified for the inputs /ˈbin.t$_{\mu}$-na$_{POSS}$/ ‘our daughter’, /ˈʤa:.b$_{\mu}$-l-i$_{OBJ}$/ ‘he brought to me’, /ˈgil.t$_{\mu}$-l$_{\mu}$-ah$_{OBJ}$/ ‘I said to him’ and /gil.t$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/ ‘I said to them’. In vowel shortening section, the outputs [ˈgil.na], [ra.ˈħ**i̲**l.hum], [ˈħam.ra], and [ʃa.ˈriʕ.ha] of the input /ˈga:.l$_{\mu}$-na$_{SUB}$/ ‘we said’, /ˈra:. ħ$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/ ‘he went to them’ /ˈħam.ˈra:ʔ/ ‘red (fm. sg.)’, and / ʃa:.ˈriʕ.ha$_{POSS}$/ ‘her street’. The unified set of constraints above has extended to reach the analysis of syncope in NA; OT determines the outputs [ˈsri.gu], [ˈʃʤa.rah], [ˈzra:.ʕah], [ˈtmaθ.θil], [ˈʃa:^{μμ}r.bah], and [ðra:ʕ] as the optimal candidates of the input /ˈsa.rag-u$_{OBJ}$/ 'they stole', /ˈʃa.ʤar-ah$_{POSS}$/ ' his tree', /zi.ˈra:.ʕah/ 'agriculture', /ti.ˈmaθ.θil/ 'you act or he /she acts', and /ði.ˈra:ʕ/ 'an arm'. The same unified set of constraints will be used in the next section to compare NA and UHA regarding CV metathesis, vowel epenthesis, and syncope in order to show the power of OT as a theory of cross-linguistic variation.

5.7 NA vs. UHA: An OT Analysis

This section is addresses CV metathesis, vowel epenthesis, and syncope as variations that distinguish NA from UHA, as the most common dialects in Saudi Arabia.[54] UHA was researched by Al-Mohanna (1998) who focused on syllabification in this dialect. However, he did provide a comparison between this dialect and NA regarding syllable structure processes in both dialects. UHA is one of the dialects that does not allow complex onsets while word-final clusters in this dialect are conditioned by the SSP; final consonant clusters that violate the SSP are avoided by vowel epenthesis, as mentioned in subsection 3.2.1 . Complex onsets in the surface form are permitted in NA regardless of the SSP, as discussed in subsection 5.3.2.1. Word-final clusters are conditioned by the SSP in NA, except if vowel epenthesis, used to avoid the violation of the SSP, results in changing the lexical categories of nouns, as discussed in subsection 5.3.2.1. In the next subsections, CV metathesis along with vowel epenthesis and syncope will be discussed as processes which differentiate NA from UHA in light of OT.

5.7.1 CV Metathesis and OT

As discussed in sections 3.5 and 5.2, non-emphatic gutturals in the coda position of non-final syllables are avoided in some modern Arabic dialects either by vowel epenthesis after gutturals or CV-metathesis while other dialects can tolerate these gutturals in the same position. In NA, non-emphatic gutturals in the coda position of non-final syllables motivate CV-metathesis which results in a complex onset, whereas these gutturals are neither avoided by CV-metathesis nor vowel epenthesis in UHA. In other words, CV-metathesis that results in a complex onset is not allowed in UHA since this dialect bans complex onsets, as mentioned at the beginning of this section; e.g., /ˈgah.wa/→ [ˈgah.wa] 'coffee'. The set of constraints in (5.97) will be used in the

[54] UHA is a dialect spoken in the western province in Saudi Arabia.

following tableau to analyse the NA output [ˈgha.wa] and the UHA output [ˈgah.wa] of the input /ˈgah.wa/ ‘coffee’:

(5.96)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY >> SSP >>*CLASH >>WSP>> MAX-C>>No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >>*COMPLEX$_{CODA}$ >>*CODA

/ˈgah.wa/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a.ˈgah.wa							*!									*							*
☞b.ˈgha.wa										*	*					**			*				

The set of constraints in (5.96) identifies candidate (b) for NA output, as optimal since it avoids the violation of the SYLLCON constraint while the same constraint is violated by candidate (a), the UHA output, due to rising sonority across a syllable boundary. On the other hand, the UHA output can be optimal if the unified set of constraints below is used:

(5.97)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_{\sigma}$ >>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO >>MAX-μ-IO>>*LLL>>DEP-IO>>*COMPLEX$_{CODA}$>>*CODA

The unified set of constraints in (5.97) will used to evaluate the NA and UHA outputs of the input /ˈgah.wa/ ‘coffee’:

(5.98)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_{\sigma}$>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*LLL>>DEP-IO>> *COMPLEX$_{CODA}$>>*CODA

/ˈgah.wa/	ONS	*COMPLEX$_{ONS}$	LINEARITY	*3μ	VA	*[VP	O-CONTIG	SYLLCON	*CVV.CV]$_{\sigma}$	*i]$_{\sigma}$	*LENITION-GUTTURAL	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*LLL	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞ a.ˈgah.wa								*									*						*
b.ˈgha.wa		*!	*									*					**			*			

The set of OT constraints in (5.97) in that ranking helps to select candidate (a), as the UHA output, as an optimal candidate since this candidate avoids the violation of the *COMPLEX$_{ONS}$ and LINERITY constraints. These constraints are violated by candidate (b), as the NA output. The rankings of the sets of OT constraints in (5.96) and (5.97) are used in the next tableaux to compare between NA and UHA.

(5.99)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL >> LINEARITY >> SSP>> *CLASH >>WSP>> MAX-C>>No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$>>*CODA

/ˈnaχ.lah/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈnaχ.lah							*!									*							**
☞b.ˈnχa.lah										*	*					**							*

Tableau (5.99) selects candidate (b) as optimal candidate for NA because it avoids the violation of the SYLLCON by CV-metathesis. This process is blocked in candidate (a), which is the UHA output, as it results in rising sonority across a syllable boundary, thereby violating the SYLLCON. However, candidate (b) can be optimal if the *COMPLEX$_{ONS}$ and LINERITY are ranked higher than SYLLCON as shown in the next tableau:

(5.100)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_σ$>>*i]$_σ$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*LLL>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈnaχ.lah/	ONS	*COMPLEX$_{ONS}$	LINERITY	*3μ	VA	*[VP	O-CONTIG	SYLLCON	*CVV.CV]$_σ$	*i]$_σ$	*LENITION-GUTTURAL	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*LLL	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a. ˈnaχ.lah								*									*						*
b.ˈnχa.lah		*!	*									*					**			*			*

Candidate (a) which is the UHA output is identified as an optimal candidate because it satisfies the *COMPLEX$_{ONS}$ and LINERITY constraints, compared to candidate (b) as the NA output. In the next subsection, vowel epenthesis will be discussed as one of processes that distinguish NA from UHA within OT.

5.7.2 Vowel epenthesis and OT

Vowel epenthesis in NA and UHA is motivated by sonority violation found in word-final clusters as discussed in subsection 3.2.1 and 5.3.2.2. Also, non-final superheavy syllables of the form CVCC that are associated with consonant-initial suffixes are avoided by vowel epenthesis in both dialects. However, the site of vowel epenthesis is different in NA and UHA when dealing with a non-final CVCC that is followed by a consonant-initial suffix, depending on morphological and sonority conditions. For instance, in NA, vowel epenthesis is inserted between the members of a word-final cluster that violates the SSP even if a non-final CVCC is followed by a consonant-initial suffix; e.g., /ˈbaħ.r$_μ$.na/ → [ba.ħ**a**r.na] ‘our sea’. This shows that vowel epenthesis in this case is conditioned by sonority violation, i.e. Reverse Sonority. In UHA, vowel epenthesis is conditioned by sonority violation when dealing with the word-final cluster in the form CVCC that constitues Reverse Sonority; e.g., /ˈbaħ.r/→[ˈba. ħ**a**r] ‘sea’. The site of vowel epenthesis is different when the input /ˈbah.r/ is associated with /-na/ as a consonant-initial suffix, i.e. /ˈbaħ.r$_μ$-na/→ [ˈbaħ.r**a**.na] ‘our sea’. Vowel epenthesis in this case is determined by a morphological condition which aims to avoid a non-final

CVCC syllable. The NA output [ba.ħ**a**r.na] and UHA output [ˈbaħ.r**a**.na] are evaluated in the next tableau using the set of constraints in (5.96):

(5.101)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_σ$>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL >> LINEARITY >> SSP>> *CLASH >>WSP>>MAX-C>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$ >>*CODA

/ˈbaħ.r$_μ$-na$_{POSS}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	SYLLCON	*i]$_σ$	*LENITION-GUTTURAL	LINEARITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈbaħ.r**a**.na							*!									**					*		*
☞b. ba.ħ**a**r.na																**				*	*		*

Candidate (b), as the NA output, is identified as optimal due to the avoidance of the violation of the SYLLCON constraint while the same constraint is violated by candidate (a), as the UHA output, where sonority rises across a syllable boundary. The unified set of constraints in (5.97) will be used in the next tableau to evaluate NA and UHA outputs of the input /ˈbaħ.r$_μ$-na/:

(5.102)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_σ$>>*i]$_σ$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*LLL>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈbaħ.r$_μ$-na$_{POSS}$/	ONS	*COMPLEX$_{ONS}$	LINERITY	*3μ	VA	*[VP	O-CONTIG	SYLLCON	*CVV.CV]$_σ$	*i]$_σ$	*LENITION-GUTTURAL	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*LLL	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a. ˈbaħ.r**a**.na								*									**				*		*
b. ba.ħ**a**r.na							*!										**				*		*

The UHA output, candidate (a), is a winning candidate since it avoids the violation of the O-CONTIG constraint. The internal epenthesis in the NA output, candidate (b), helps to avoid the violation of the SYLLCON but this epenthesis results in the violation of the O-CONTIG constraint.

The non-final superheavy syllable of the form CVVC that is followed by a consonant-initial suffix is treated differently in both dialects. In UHA, the non-final CVVC is avoided by vowel epenthesis; e.g., /ˈbe:$_{\mu\mu}$.t$_{\mu}$-ha$_{\text{POSS}}$/⟶ [ˈbe:$_{\mu\mu}$.t**a**$_{\mu}$.ha$_{\mu}$] ‘her house’. In NA, a non-final superheavy syllable that is associated with a consonant-initial suffix is avoided by mora sharing, as mentioned in subsection 5.3.3.1; e.g., /ˈbe:$_{\mu\mu}$.t$_{\mu}$-ha$_{\text{POSS}}$/⟶ [be:$^{\mu\mu}$t. ha$_{\mu}$] ‘her house’. The NA and UHA outputs of the input /ˈbe:$_{\mu\mu}$.t$_{\mu}$-ha$_{\text{POSS}}$/ undergo the evaluation by the unified set of constraints in (5.96) in the next tableau:

(5.103)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL >> LINEARITY >> SSP>> *CLASH >>WSP>> MAX-C>>No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{\text{ONS}}$>>O-CONTIG >> DEP-IO >>*COMPLEX$_{\text{CODA}}$ >>*CODA

/ˈbe:$_{\mu\mu}$.t$_{\mu}$-ha$_{\text{POSS}}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{\text{ONS}}$	O-CONTIG	DEP-IO	*COMPLEX$_{\text{CODA}}$	*CODA
a. ˈbe:$_{\mu\mu}$.t**a**$_{\mu}$.ha$_{\mu}$						*!										*					*		*
☞b. ˈbe:$^{\mu\mu}$t. ha$_{\mu}$							*									*							*

The UHA output, candidate (a), avoids the violation of the SYLLCON constraint by vowel epenthesis after a semisyllable /t$_{\mu}$/ but this epenthesis results in the formation of an unstressed light penultimate syllable that follows a heavy stressed antepenultimate syllable, i.e. [ˈCVV.CV.CV]. As a result, this candidate is eliminated from being optimal due to the violation of the *CVV.CV]$_{\sigma}$ constraint. Candidate (b) is optimal since it avoids the violation of the same constraint by mora sharing. The same outputs undergo the evaluation by the unified set of constraints in (5.97) in the next tableau:

(5.104)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_σ$>>*i]$_σ$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*LLL>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈbe:$_{μμ}$.t$_μ$-ha$_{POSS}$/	ONS	*COMPLEX$_{ONS}$	LINERITY	*3μ	VA	*[VP	O-CONTIG	SYLLCON	*CVV.CV]$_σ$	*i]$_σ$	*LENITION-GUTTURAL	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*LLL	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a.ˈbe:$_{μμ}$.t**a̲**$_μ$.ha$_μ$									*								*				*		
b.ˈbe:^{μμ}t. ha$_μ$								*!									*						*

The SYLLCON constraint which outranks the *CVV.CV]$_σ$ constraint is satisfied by the UHA output, candidate (a). Therefore, this candidate is identified as optimal, whereas the NA output, candidate (b) fails to be optimal due to the violation of the SYLLCON constraint. Syncope, as the last variation, in NA and UHA will be discussed in detail in light of OT in the next subsection.

5.7.3 Syncope and OT

As discussed in section 5.5, syncope in NA targets an unstressed short vowel in a non-final light syllable that is followed by the syllable of the form CVVC, i.e. this process results in a complex onset. Also, the three light syllables that result from the association of nouns and verbs of the form CV.CVC with vowel-initial suffixes are reduced by syncopating a vowel in the light antepenultimate syllable (trisyllabic elision); e.g., /ˈba.gar/→ the attachment of a vowel-initial possessive suffix /-ak/ → /ˈba.ga.rak/→ [ˈbga.rak] ‘your cows’. An unstressed short vowel in a light antepenultimate syllable that is followed by a heavy syllable in the underlying form undergoes syncope; e.g., /zi.ˈra:ʕah/→ [ˈzra:ʕah] ‘agriculture’. However, in UHA, low vowels are not targeted by syncope when dealing with three light syllables in order to avoid complex onsets; e.g., /ˈba.gar-ak/→ [ˈba.ga.rak] ‘your cows’. Likewise, the syncope of unstressed high short vowels in non-final light syllables that are followed by CVVC syllables; e.g., /gu.ˈbu:r/ → [ˈgbu:r] ‘graves’. The unified set of constraints in (5.96) will be used to evaluate the

NA output [ˈbga.rak] and UHA output [ˈba.ga.rak] of the input /ˈba.gar-ak$_{POSS}$/ ‘your cows’:

(5.105)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH >>WSP>> MAX-C>>No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$>>*CODA

/ˈba.gar-ak $_{POSS}$/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. ˈba.ga.rak		*!														***							*
☞b. ˈbga.rak																**	*	*	*				*

The UHA output, candidate (a), avoids the violation of the SYLLCON constraint by blocking the syncope of an unstressed short vowel in a light penultimate syllable but this blockage results in three light syllables that violate the *LLL constraint. The NA output, candidate (b), avoids the violation of the SYLLCON and *LLL constraints by syncopating the short vowel in a light antepenultimate syllable that is adjacent to a light penultimate syllable. As a result, this candidate is selected as the optimal candidate of the input /ˈba.gar-ak$_{POSS}$/ ‘your cows’ for NA. The unified set of constraints in (5.97) will be used to evaluate the same outputs in the next tableau:

(5.106)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_{\sigma}$>>*i]$_{\sigma}$>> *LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>> *LLL>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/ˈba.gar-ak $_{POSS}$/	ONS	*COMPLEX$_{ONS}$	LINERITY	*3μ	VA	*[VP	O-CONTIG	SYLLCON	*CVV.CV]$_{\sigma}$	*i]$_{\sigma}$	*LENITION-GUTTURAL	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*LLL	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞ a. ˈba.ga.rak																	***			*			*
b. ˈbga.rak		*!															**	*	*				*

Candidate (a), the UHA output, is successfully identified as optimal due to the satisfaction of the *COMPLEX$_{ONS}$ constraint. The deletion of a short vowel in the light antepenultimate syllable in candidate (b), the NA output, results in the violation of the *COMPLEX$_{ONS}$ constraint. Therefore, the NA output is prevented from being optimal. In the next tableau, I will evaluate the NA output [ˈzra:ʕah] and UHA output [zi.ˈra:ʕah] of the input /zi.ˈra:ʕah/ 'agriculture' using the unified set of constraints in (5.96):

(5.107)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{σ}$>>SYLLCON>>*i]$_{σ}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>> *CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/zi.ˈra:ʕah/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{σ}$	SYLLCON	*i]$_{σ}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a.zi.ˈra:ʕah								*!								**							*
☞b.ˈzra:ʕah																**	*	*	*				*

The tableau (5.107) identifies the NA output, candidate (b), as optimal because this output avoids the violation of the *i]$_{σ}$ by syncopating an unstressed high short vowel in a light antepenultimate syllable. The UHA output, candidate (a), fails to be optimal because an unstressed high short vowel in a light antepenultimate syllable is immune to syncope in order to avoid a complex onset. The unified set of constraints in (5.97) will be used in the next tableau to evaluate the same outputs:

(5.108)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_{\sigma}$>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*LLL>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/zi.ˈra:ʕah/	ONS	*COMPLEX$_{ONS}$	LINERITY	*3μ	VA	*[VP	O-CONTIG	SYLLCON	*CVV.CV]$_{\sigma}$	*i]$_{\sigma}$	*LENITION-GUTTURAL	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*LLL	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a.zi.ˈra:ʕah										*							*						*
b.ˈzra:ʕah		*!															*	*	*				*

The set of constraints in tableau (5.108) identifies candidate (a), the UHA output, as optimal because this candidate avoids the violation of the *COMPLEX$_{ONS}$ constraint, whereas the same constraint is violated by candidate (b), the NA output. Ranking the *COMPLEX$_{ONS}$ constraint higher than *LLL is appropriate for the UHA output.

The candidates [ˈgbu:r] and [gu.ˈbu:r] of the input /gu.ˈbu:r/ ‘graves’ will be evaluated in the next tableaux using the sets of constraints (5.96) and (5.97).

(5.109)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_{\sigma}$>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL >> LINEARITY >> SSP>> *CLASH >>WSP>>MAX-C>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$ >>*CODA

/gu.ˈbu:r/	ONS	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	SYLLCON	*i]$_{\sigma}$	*LENITION-GUTTURAL	LINERITY	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*COMPLEX$_{ONS}$	O-CONTIG	DEP-IO	*COMPLEX$_{CODA}$	*CODA
a. gu.ˈbu:r								*!							*								*
☞b.ˈgbu:r											*						*	*	*				*

The unstressed high short vowel in a non-final light syllable that is followed by the final stressed syllable of the form CVVC undergoes syncope in the NA output, candidate (b), in order to avoid the violation of the *i]$_{\sigma}$ constraint. The same unstressed high short vowel is immune to syncope in the UHA output, candidate (a), which results in the violation of the *i]$_{\sigma}$ constraint. Consequently, the UHA output is eliminated from being optimal. However, candidate (a), as the UHA output, can be identified as optimal using the same set of constraints in (5.97). Consider the following tableau:

(5.110)

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_σ$>>*i]$_σ$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*LLL>>DEP-IO>> *COMPLEX$_{CODA}$ >>*CODA

/gu.ˈbuːr/	ONS	*COMPLEX$_{ONS}$	LINERITY	*3μ	VA	*[VP	O-CONTIG	SYLLCON	*CVV.CV]$_σ$	*i]$_σ$	*LENITION-GUTTURAL	SSP	*CLASH	WSP	MAX-C	No [u]	No [a]	MAX-IO	MAX-μ-IO	*LLL	DEP-IO	*COMPLEX$_{CODA}$	*CODA
☞a. gu.ˈbuːr										*						*							*
b. ˈgbuːr		*!																*	*				*

The set of OT constraints in (5.110) identifies the UHA output, candidate (a), as optimal due to the satisfaction of the *COMPLEX$_{ONS}$ constraint. Candidate (b), the NA output, fails to avoid the violation of the same constraint (*COMPLEX$_{ONS}$). As a result, this set of constraints eliminates candidate (b) from being optimal.

To conclude, CV-metathesis, vowel epenthesis, and syncope were shown in this section as areas of variation that differentiate NA from UHA. These phonological processes underwent evaluation in OT; the unified set of OT constraints with distinct rankings was used to show the power of this theory for accounting for cross-linguistic variations with reference to the analysis of NA and UHA.

5.8 Summary

This chapter examined the phonological processes found in NA, especially those processes that have a clear impact on NA syllable structure such as metathesis, epenthesis, vowel shortening, and syncope. This chapter began with Metathesis (Guttural Resyllabification) as a process that results in initial bi-consonantal clusters in this dialect; hence, it was shown in section 5.2 that NA is deemed one of the dialects that cannot tolerate gutturals including Uvular, Pharyngeals , and Laryngeals in the coda position in non-final syllables. Consequently, gutturals are either resyllabified as an onset of the following syllable where vowel epenthesis is employed as its nucleus, as in Bedouin Negev Arabic, or resyllabified as a member of an initial bi-consonantal cluster, as in NA. Metathesis was analysed in OT using some constraints including LINEARITY (Pater 1995:6), SYLLCON (Bat El 1996:302), and *LLL. The LINEARITY constraint is utilized against candidate analyses where metathesis is found, while the SYLLCON constraint is for immunity to rising sonority across a syllable boundary, and *LLL militates against any candidate with three light syllables adjacent to each other. The second section dealt with the types of epenthesis in NA along with their motivators and OT analyses.

This chapter showed that initial epenthesis (prosthesis) in NA is motivated by three factors. The first factor is related to initial sequences of consonants in verbs derived from the binyan forms VII, VIII, and X. OT was used to account form initial and internal epenthesis. McCarthy & Prince (1995:108) introduce O-CONTIG constraint which is against internal epenthesis, and this constraint was ranked higher than DEP in order to eliminate candidate analyses with internal epenthesis. Secondly, according to Abboud (1979), a prosthetic vowel is found in some imperative forms in NA; /skin/→ [**ʔi**skin] ‘dwell!’

The third motivator is regarding initial geminates that result from the assimilation of a prefix with the first consonant in the stem; e.g., /ti+da.ris/→ /t.darris/→ /dda.ris/→ [ʔid.da.ris] ‘you (m.s) study’. These phenomena were analysed using OT as well. Internal epenthesis is motivated by different factors than initial epenthesis (prosthesis). It is firstly provoked by the violation of the SSP in the coda position, especially when the final consonant cluster constitutes sonority reverse by having a peripheral consonant more sonorous than the one closed to a nucleus; e.g. /nahr/→ [na.h**a**r] ‘river’. However, this type of violation is somehow tolerated in order to avoid any change in lexical categories words; e.g., /gatˤʕ/→ [gatˤʕ] ‘cut (n.)’/*[gatˤ**a**ʕ] ‘he cut’. Internal epenthesis and sonority violation were accounted for using OT.

Non-final superheavy syllables, CVVC and CVCC, were shown in this chapter as a motivator for an internal epenthesis when they are associated with a dative plus a consonant-initial suffix. Furthermore, the difference between CVCC and CVVC regarding mora sharing is demonstrated as well; hence, like Moroccan Arabic, in NA, a non-final superheavy syllable CVVC is avoided by mora sharing when this syllable is suffixed with a consonant-initial affix, while a CVCC motivates vowel epenthesis when it is associated with a consonant-initial affix, unless a final consonant cluster is labelled as a geminate. To put it simply, I refer to Watson’s (2007) analysis of non-final superheavy syllables and found that a non-final CVVC has a similar treatment in NA through the permission of mora sharing to avoid non-final superheavy syllables, especially when it is preceded by a consonant-initial affix. Non-final superheavy syllables in NA were analysed using OT by using the constraints *3μ and *CVV.CV]$_{\sigma}$. The *3μ constraint disfavors trimoraic syllables and the *CVV.CV]$_{\sigma}$ is against any candidate with a stressed heavy antepenultimate of the form CVV that is followed by an unstressed light syllable.

This chapter also dealt with vowel shortening as well as other phonological processes since it plays a role in changing syllable structure in NA. It was shown as a process motivated by three factors. The first factor is related to the association of a hollow verb with a consonant–initial subject agreement suffix; e.g., /ʃa:.l$_{\mu}$+t$_{SUB}$/→ [ʃilt] ‘you (m sg.) carried’. The shortened vowel in this case undergoes vowel ablaut. The second motivator is related to the avoidance of unstressed heavy syllables of the form CVV when a hollow verb is associated with dative and a consonant-initial suffix; e.g., /ˈga:.l$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/→ [ga$_{\mu}$.ˈl**i**$_{\mu}$l$_{\mu}$.hu$_{\mu}$m] ‘he said to them’. This motivator is not only found in hollow verbs: a long low vowel in unstressed final heavy syllables CVV that result from the deletion of the final glottal stop in some adjectives is targeted by vowel shortening in order to comply with the WSP constraint, i.e. this constraint militates against unstressed heavy syllables. The final factor is to avoid stress clash which prominently results from having two stressed syllables adjacent to each other in some nouns; vowel shortening targets an a long vowel in a stressed heavy syllable of the form CVV; e.g.,

/ˈba:.bi:n/→ [ba.ˈbi:n] ‘two doors’. With regard to OT analysis, the VOWEL ABLAUT (VA) constraint requires a shortened vowel that results from the association of a hollow verb with a consonant-initial subject agreement suffix. The WSP is also used to avoid unstressed heavy syllables. The *CLASH constraint militates against adjacent stressed syllables.

Syncope was explained in this chapter as a phonological process that affects the syllable structure in NA along with other processes. This process is used in NA to reduce the three light syllables in nouns and verbs of the form ˈCV.CVC that result from the association of this form, ˈCV.CVC, with a vowel-initial suffix; a short vowel in a stressed light antepenultimate syllable undergoes syncope since this syllable is adjacent to an umstressed light penultimate syllable, i.e. /ˈCV.CVC-VC/→/ˈCV.CV.CVC/→ [ˈCCV.CVC]. The short vowel in an unstressed light antepenultimate syllable that is followed by a stressed heavy penultimate in the underlying form undergoes syncope; e.g., /zi.ˈra:.ʕah/→ [ˈzra:.ʕah] ‘agriculture’. An unstressed short vowel in a non-final light syllable is not immune to syncope when this syllable is followed by any CVVC syllable with reference to NA; e.g., /gu.ˈbu:r/→ [ˈgbu:r] ‘graves’. However, syncope is blocked in NA if it results in a non-final CVCC syllable; e.g., /ˈjak.tib-ah$_{\text{OBJ}}$/→ [ˈjak.ti.bah]/ *[ˈjakt.bah] ‘he writes it (m. sg.)’. Also, syncope is not allowed when dealing with the form ˈCV.CVC that is associated with a consonant-initial affix for two reasons; firstly, this association does not result in three light syllables where the short vowel in a light antepenultimate syllable undergoes syncope. Secondly, a non-final syllable is stressed in the underlying form before the association of a consonant-initial suffix, compared to an unstressed vowel in a light antepenultimate syllable in /zi.ˈra:.ʕah/ ‘agriculture’, for example, where an unstressed short vowel is not protected from syncope. There is an exceptional case where unstressed short vowels in non-final light syllables do not undergo syncope, even though these vowels are in appropriate environments for syncope. For instance, an unstressed short vowel in a non-final light syllable in the input /mu.ˈdi:r/ ‘manager’ is not targeted by syncope in NA. Likewise, an unstressed high short vowel in a light penultimate syllable in the input /ˈma.li.kah/ ‘queen’ is immune to syncope. The reason for these vowels being immune to syncope is the government by SA phonology. In other words, these vowels are in words borrowed from SA and they should not undergo an analysis of NA phonology.

The unified set of OT constraints in section (5.6) is the answer to the question related to syllable structure processes that can be gained through OT. In other words, the insights about related syllable structure processes like CV metathesis, epenthesis, vowel shortening, and syncope is shown in section (5.6) as processes that can be analyzed by OT.

At the end of this chapter, the unified set of OT constraints was used in section (5.7) in order to account for CV metathesis, vowel epenthesis, and syncope as variations that can differentiate NA from UHA. In this section, OT was shown as a theory capable of accounting for cross-linguistic variations.

Chapter 6. Conclusion

The aims of this thesis were twofold. The first aim was to examine what impact phonological processes including metathesis, epenthesis, vowel shortening, and syncope have on syllable structure in NA. The second aim was to show what insights about NA syllable structures and related processes can be gained through OT analyses. In order to address these objectives, this thesis considered the five following questions:

1. What insights about Najdi syllable structure and related processes can be gained thorough OT?
2. What is the source of initial bi-consonantal clusters in NA?
3. To what extent are sonority violations tolerated in final consonant clusters in Najdi?
4. How are non-final superheavy syllables of the forms CVVC and CVCC avoided in Najdi?
5. What are the motivating factors for vowel shortening in NA?

The first chapter presented the geographical context of Najd province where NA is spoken, and described the dialect investigated; NA consonant and vowel inventories were described. The types of consonants in NA were shown in this chapter. Furthermore, lenition along with the treatment of the glottal stop were discussed as phenomena specific to the NA consonant inventory. In addition, the NA vowel inventory and related phenomena, including vowel raising and lowering, were illustrated along with the consonant inventory.

The second chapter was devoted to the theoretical background on syllable structure. This chapter sheds light on the importance of the syllable in the overall theory of grammar, the internal structure of the syllable, the syllable and sonority hierarchy, the syllable in Arabic, and OT. The importance of the syllable in the overall theory of grammar was briefly explained through the example of syllable and stress assignment (suprasegmental phonology). Syllable weight and position were demonstrated to be reliable factors that can determine stress assignment in Arabic with reference to stress parameters in CA (Al-ani 1979). The following section (2.3) was allocated to demonstrating the structure of the syllable in general in which a nucleus was the most obligatory constituent in the structure of any syllable. The next section (2.4) dealt with the relation between the syllable and sonority hierarchy. In this section, the sonority scale introduced by Selkirk (1984) was deemed universal but not comprehensive since the sonority values of affricates are not included in this scale. Therefore, I adhered to the sonority scale introduced by Parker (2002, 2008) which precisely shows the sonority values of all obstruents. Regarding sonority distance, some word-initial clusters that comply with the SSP are not permitted in some languages due to sonority distance between the members of these clusters. For instance, according to Roca and Johnson (1999), /ps-/ and /pn-/ clusters are not allowed in English while they are found in Greek. This shows that English does not accept word-initial clusters with a sonority distance less than two. Likewise, Spanish does not allow word-initial clusters where the sonority distance is less than two intervals such as /pn-/ and /ml-/. After that, I illustrated the syllable types in SA in order to show which syllables are accommodated by modern Arabic dialects and which syllable types in these dialects are not found in SA. This section was divided into two subsections; the first subsection focused on syllable weight and extrametricality in Arabic and the second subsection was related to non-final superheavy syllables in semisyllables in Arabic. The final section in this chapter is about OT and syllable structure processes that undergo the analysis of this framework: insertion (epenthesis), syncope, vowel shortening, and CV metathesis.

The third chapter showed the major syllable structure processes in Arabic including epenthesis, vowel shortening, syncope, and metathesis in modern Arabic dialects. This chapter began with vowel epenthesis as a process commonly found in most modern Arabic dialects by viewing the motivating factors for this process: sonority violation, complexity in the onset position, and non-final superheavy syllables. Vowel shortening in some modern Arabic dialects was illustrated in this chapter by scrutinizing the motivating factors for this behaviour. A long vowel in a hollow verb of the form CaaC is targeted by vowel shortening when this verb is associated with a consonant-initial subject agreement suffix in UHA and Ma'ani Arabic (Al-Mohanna 1998 and Rakhieh 2009); e.g., /ʤ**a:**b+na$_{SUB}$/→ [ʤib.na$_{SUB}$] 'we brought'. The second motiovator for vowel shortening is the avoidence of unstressed heavy syllables that results from the deletion of a final glottal stop. Harrama (1993) who focused in his study on Al-Jabal dialect in Libya states that a long vowel in an unstressed heavy syllable CVV that results from the deletion of a final glottal stop undergoes vowel shortening; e.g., /ˈħam.ˈraaʔ/→ /ˈħam.raa/→[ˈħam.ra] 'red (fm.)'. Rakhieh (2009) notes that stress clash is considered to be another motivating factor for long vowel shortening in Ma'ani Arabic; e.g., /ˈba:.ˈbi:n/→ [ba.ˈbi:n]/*[ˈba:.ˈbi:n] 'two doors'.

This chapter also highlighted syncope in some modern Arabic dialects along with its motivating factors. For instance, Al-Mozainy (1981) states that an unstressed short vowel in a non-final open light syllable syncopates when this syllable is followed by syllables in the forms CVVC and CVCC, resulting in initial bi-consonantal clusters in BHA; e.g., /ku.ra:ʕ/→ [kra:ʕ] 'leg'. In addition, Harrama (1993) observes that initial consonant clusters in the Al-Jabal dialect of Libya results from syncopating the unstressed short vowel in a non-final open light syllable followed by a final syllable of the form CVVC; e.g., /j**i**.ˈgu:l/→ [ˈjgu:l] 'he says'. Syncope in some modern Arabic dialects targets an unstressed short vowel in a light penultimate syllable that results from the association of the form ˈCVV.CVC with a vowel-initial affix. Likewise, an unstressed high short vowel in a light penultimate syllable is not immune to syncope in some dialects including BHA (Al-Mozainy 1981), UHA (Al-Mohanna 1998), Iraqi Arabic (Farawneh 1995 & Rose 2000), and San'ani Arabic (Watson 2002); e.g., /ʃa:.ʕir+ak$_{\mathrm{POSS}}$/→[ʃa:ʕ.rak] 'your (ms. sg.) male poet'. However, syncope that forms a non-final CVCC is blocked with reference to UHA (Al-Mohanna 1998): e.g., /jiħ.rig-u/→[jiħ.r**i**.gu]/*[jiħr.gu] 'they burn'. Also, syncope is incapable of targeting an unstressed short vowel in a non-final open syllable in words that are governed by the phonology of SA (Rakhieh 2009); e.g., /mu.di:r/→[mu.di:r] /*[mdi:r] 'manager'. TSE is another type of syncope responsible for creating initial bi-consonantal clusters in some modern Arabic dialects including Jordanian Arabic (Irished 1984, Sakarna 1999, 2005, and Rakhieh 2009) and NA (Al-Mozainy 1982). In the same chapter, syncope in connected speech was demonstrated with reference to Salem's (2005) study on colloquial Egyptian Arabic, even though it is not the central focus in this thesis (see footnote 18). Metathesis is illustrated in this chapter as a phonological process that results in initial bi-consonant clusters, according to Abboud (1979) and Ingham (1994), Zawaydeh (1999) Blevins& Garrett (2004), and Al-Solami (2013)This behaviour was reported in NA by bi-consonant clusters, according to Abboud (1979) and Ingham (1994), Zawaydeh (1999) Blevins& Garrett (2004), and in BHA by Al-Mozainy (1981) and Zawaydeh (1999) and Al-Solami (2013): /CVG.CV/→/CGV.CV/. Non-emphatic gutturals in the coda position of non-final syllables motivate CV metathesis with reference to NA and BHA. However, these studies did not account for this behaviour using OT, whereas this process in this thesis was accounted for using this theory in chapters 4 and 5.

The fourth chapter presented some characteristics of the phonology of NA. There were two questions addressed in this chapter: the first question was related to the source of word-initial and word-final clusters in this dialect and the second question was about the insights into NA syllable structure that can be gained through OT. This chapter started with a section about the way that the input in NA is determined with reference to *Lexicon Optimization* (Yip 1996 & Kager 1999); some inputs in NA map onto NA outputs, whereas other NA inputs map onto SA outputs since this type of inputs is governed by SA phonology at the output level. The following section demonstrated syllable types and their distribution in NA. The syllable types in NA are CV, CVC, CVV, CVVC, CVCC, CCV, CCVC, CCVV, CCVVC, and CCVCC. These syllable types are gathered in three groups; light syllables are CV and CCV. Heavy syllables are CVC, CVV, CCVC, and CCVV. Superheavy syllables are CVVC, CVCC, CCVVC, and CCVCC. With regard to the distribution of these syllables, CV syllables are found initially as stressed when the following syllables, final ones, are of the form CVC where the last consonants are assigned as extrametrical, i.e., /ˈki.ta<b>/ ‘he wrote’. There is a restriction on CVV syllables; this type of syllable is found in the non-final position as a heavy syllable. Superheavy syllables of the forms CVVC and CVCC are treated differently in NA in terms of their position. For instance, CVVC syllables are found in non-final position as heavy syllables using mora sharing in order to avoid semisyllables, except if these syllables are followed by datives and consonant-initial suffixes. These syllables are found heavy and stressed in the final position because the last consonant is assigned as extrasyllabic. CVCC syllables are not allowed in the non-final position since semisyllables in this case are avoided by vowel epenthesis while they are found heavy and stressed in the final position where the last consonant is assigned as extrasyllablic. Syllables of the forms CCV, CCVC, CCVV, and CCVVC are found in non-final positions. The CCVCC syllable is found only in monosyllabic words; e.g., /simint/→ [smint] ‘cement’. The following section demonstrated that syllable inventories in languages can be attributed to the interaction of faithfulness and markedness constraints in OT. The markedness constraints including ONS, *CODA,

$*COMPLEX_{ONS}$, and $*COMPLEX_{CODA}$ are universal as well as MAX and DEP as faithfulness constraints. The ranking of these constraints is different from one language to another (language-specific). For instance, ONS is ranked as the highest constraint in languages where onsetless syllables are not permitted. Also, the $*COMPLEX_{ONS}$ is ranked as one of higher constraints in languages where complex onsets are banned. However, ONS is not ranked as the highest constraint in languages that tolerate onsetless syllables. The $*COMPLEX_{CODA}$ constraint is ranked as one of higher constraints in languages complex codas are not allowed. The *CODA is low-ranked in languages where syllables have codas. The next sections addressed the question of the source of word-initial and word-final clusters in NA using OT. There are two types of onsets in NA: simple and complex onsets. Simple onsets are obigatory, whereas complex onsets are optional and they are created by syncope and CV metathesis. Unlike onsets in NA, codas, either simple or complex, are optional in NA because some syllable types in this dialect lack codas. The difference between word-initial and word-final clusters is that word-initial clusters are created by syncope and CV metathesis, whereas complex codas are underlying. The types of codas in NA are analysed by OT as well as onsets. The relation between stress parameters and weight of the syllables in NA was discussed in the following section. For example, the final CVC syllable is deemed unstressed and light since the last consonant in this syllable is assigned as extrametrical; this syllable complies with the extrametricality rules (Hayes 1995) discussed in subsection 2.5.1. The extrametricality rules cannot be applied to a non-final CVC syllable which is unstressed; this syllable is heavy in this case. This behaviour is accounted for using OT: the *FINAL-C-μ constraint is used to eliminate any candidates where the prosodic words end with moraic codas. According to the stress parameter in (VII) in the same section, there is a restriction on the position of the CVG syllable in disyllabic words. Consequently, the word-final geminate is the target of degemination and the last consonant is assigned as extrametrical. The stress is received by the preceding syllable (regression of stress); e.g., /ji.ˈmidd/→ degmination→ [ˈji.mid] ‘he spreads’. This behaviour is accounted for using OT: the *FINAL-G constraint is against word-final geminates and the *3μ is violated by candidates with tri-moraic syllables. The following section dealt with the treatment of superheavy syllables of the forms CVVC and CVCC. This section was divided into two subsections. The first subsection demonstrates these syllables in a non-final position using OT; non-final superheavy syllables are heavy syllables of the form CVV and CVC followed by semisyllables.

Non-final CVCC syllables that are associated with consonant-initial suffixes are avoided by vowel epenthesis while non-final superheavy syllables CVVC that are associated with consonant-initial suffixes are avoided by mora sharing rather than vowel epenthesis: i.e., a semisyllable shares a mora with the second member of a long vowel in the non-final syllable. The second subsection discussed these syllables in the final position; these syllables are heavy and stressed where their final consonants are labelled as extrasyllabic. In terms of OT analysis, some constraints are used to analyse these syllables regarding their positions. For instance, the SYLLCON constraint is against rising sonority across the syllable boundary and the *3μ constraint eliminates candidates with tri-moraic syllables. The *FINAL-C-μ constraint is used to eliminate any candidate with a final moraic consonant. The unified set of constraints in the final section was presented after demonstrating the weight of the syllable and superheavy syllables in NA, in order to address the question of what insights about NA syllable structure can be gained through OT. This set in (6.1) is shown to be capable of analysing the syllable structure in this dialect.

(6.1)

ONS>>*LLL>>*3μ>>SYLLCON>>*i]$_{\sigma}$>>*LENITION-GUTTURAL>>LINEARITY>>SSP>>*FINAL-G>>MAX-IO>> *FINALC-μ >> MAX-μ-IO >>*COMPLEX$_{ONS}$>>DEP>> *COMPLEX$_{CODA}$ >>*CODA

The fifth chapter addresses the insights about related processes in NA that can be gained using OT. To put it another way, this chapter tackled the phonological processes that had an impact on NA syllable structure in light of OT. Firstly, the complexity in the onset position in this dialect resulted from Guttural Resyllabification (metathesis) since gutturals, excluding emphatics, were not tolerated being in the coda position of a non-final syllable. This type of metathesis was motivated by gutturals being in the coda position of a non-final syllable, resulting in an initial consonant cluster; e.g., /g**<u>ah</u>**.wa/→ [g**<u>ha</u>**.wa] 'coffee'. This phonological process has been recognised by scholars who work on NA and other Bedouin Arabic dialects including Abboud (1979), Ingham (1994), Zawaydeh (1999), and Blevins & Garrett (2004). This chapter was also dedicated to analyzing the types of epenthesis of NA.

Initial epenthesis was shown as a phenomenon motivated by different factors, compared to internal epenthesis. The first motivator factor regarded initial sequences of consonants in verbs derived from the binyans VII, VIII, and X. OT was used to eliminate internal epenthesis in this case, even though this type of epenthesis resulted in a possible syllabification as did prosthesis. McCarthy and Prince (1995:108) introduced the O-CONTIG constraint as a solution to the problem regarding the elimination of internal epenthesis. Some imperative forms in NA were demonstrated as those which motivate prosthesis; e.g., /skin/→ [**ʔi**skin] 'dwell!'. Initial geminates, which result from the assimilation of a prefix and a first consonant in a stem, motivated initial epenthesis; e.g., /ti+daris/→/tdaris/→/ddaris/→ [ʔid.daris] 'you (m.s.) study'. I referred to the O-CONTIG constraint in order to eliminate candidates with internal epenthesis.

The motivating factors for internal epenthesis were demonstrated as well as the motivators for prosthesis. The first motivator regarded Reverse Sonority, as one of the manners of SSP violation, in the coda position. This violation was analyzed by OT in order to optimise an output that was immune to Reverse Sonority as an optimal output, but since the avoidance of this sonority could be solved either by peripheral or internal epenthesis, another constraint was required to optimise an output that has internal epenthesis and avoid the one that has peripheral epenthesis. Therefore, the SYLLCON with the SSP constraints were found useful for banning candidates with sonority violation and sonority rising across a syllable boundary from being optimal. However, I indicated instances of lexical distinctness in which sonority violation, Reverse Sonority, is tolerated in order to avoid changes in lexical category of words; e.g., /gatˤʕ/→ [gatˤʕ] 'cut (n.)'/*[gatˤ**a**ʕ] 'he cut'. This argument suggests a way of identifying vowel epenthesis; I observed that vowel epenthsis in NA could be determined by a stem vowel, as in [ʔið**i**n] 'ear', the first member of a final consonant cluster, as in /nahr/→ [na.h**a**r] 'river', but the epenthetic vowel [u] in the output [sˤa.b**u**r] 'patience', for example, is determined by a consonant cluster in which the first member is not [+pharyngeal] and the second member is /r/. Likewise, an epenthetic vowel [i] in the output [ʔak**i**l] is determined by in the first member of the final cluster, as [-pharyngeal], and the second member /l/.

Non-final superheavy syllables, CVVC and CVCC, are considered to be motivators for an internal epenthesis when they are associated with datives plus consonant-initial suffixes. The difference between CVCC and CVVC is particular to mora sharing. For instance, a non-final superheavy syllable CVVC is avoided by mora sharing when this syllable is associated with a consonant-initial suffix; e.g., /be:.tμ-hum$_{\text{POSS}}$/→ [be:$^{\mu\mu}$t.hum$_{\text{POSS}}$] 'their house'. Likewise, mora sharing is used to avoid a non-final superheavy syllable CVVC when it is associated with a dative plus a vowel-initial suffix; e.g., /ʤa:.b$_{\mu}$-l$_{\mu}$-i$_{OBJ}$/→ [ʤa:$^{\mu\mu}$b.li$_{OBJ}$] ‘he brought to me’. However, this syllable motivates vowel epenthesis when it is associated with a dative plus a consonant-initial suffix; e.g., /ʤa:.b$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/→ [ʤa:.b**i**l.hum$_{OBJ}$] ‘he brought to them’. Similarly, vowel epenthesis is motivated by a non-final CVCC syllable that is associated with a consonant-initial suffix; e.g., /bin.t$_{\mu}$-na$_{POSS}$/→ [bin.t**i**.na] ‘our daughter’. Also, a non-final CVCC syllable that is associated with a dative plus a vowel or consonant-initial suffix; e.g., /gil.t$_{\mu}$-l$_{\mu}$-i$_{OBJ}$/→ [gil.t**i**.li] ‘you said to me’, /gil.t$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/→ [gil.t**i**l.hum] ‘I said to them’. Non-final superheavy syllables in NA were analysed within OT by using the constraints *3μ and *CVV.CV]$_{\sigma}$. The *3μ constraint disfavours trimoraic syllables and the *CVV.CV]$_{\sigma}$ is against any candidate with a stressed heavy antepenultimate of the form CVV that is followed by an unstressed light syllable.

Vowel shortening was illustrated in this chapter as a phonological process motivated by three factors. The first factor is when a hollow verb is associated with a consonant-initial subject agreement suffix; e.g., /ʃa:l+t$_{SUB}$/→ [ʃilt] ‘you (m sg.) carried’. Vowel ablaut targets a shortened vowel that results from the association of a hollow verb with a consonant-initial subject agreement suffix. The second factor is to avoid an unstressed heavy syllable that results from the association of a hollow verb with a dative plus a consonant-initial suffix; e.g., e.g., /ˈga:.l$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/→ [ga$_{\mu}$.ˈl**i**$_{\mu}$l$_{\mu}$.hu$_{\mu}$m]. This process not only targets hollow verbs but it targets a long vowel in an unstressed heavy syllable of the form CVV in some adjectives that results from the deletion of a final glottal stop; e.g., /ˈħam.ˈra:ʔ/→ /ˈħam.ra:/→ [ˈħam.ra] ‘red (fm. sg.)’. The final factor is to avoid stress clash which prominently results from having two stressed syllables adjacent to each other in some nouns; vowel shortening targets an a long vowel in a stressed heavy syllable of the form CVV; e.g., /ˈba:.bi:n/→ [ba.ˈbi:n] ‘two doors’. With regard to OT analysis, the VOWEL ABLAUT (VA) constraint requires a shortened vowel that results from the association of a hollow verb with a consonant-initial subject agreement suffix. The WSP is also used to avoid unstressed heavy syllables. The *CLASH constraint is against adjacent stressed syllables.

The final phonological factor was syncope which resulted from the attachment of a vowel-initial affix. Simply put, a vowel in non-final open light syllable of the form CV.CVC becomes unstressed (stress shifting) due to the attachment of a vowel-initial affix. As a result, this vowel is targeted by syncope; e.g., /ka.sar-u/→ [ksa.rau] ‘they broke’. Also, syncope is found in the phenomenon known as a trisyllabic elision which aims to reduce the number of light syllables in trisyllabic words. A short vowel in a light antepenultimate syllabe undergoes syncope; e.g., /ba.ga.ra/→[bga.ra] ‘cow’. Likewise, an unstressed vowel in a light antepenultimate undergoes syncopation when this syllable is followed by a heavy penultimate syllable of the forms CVV, CVG or CVVC; e.g., /si.ˈba:.kah/→ [ˈsba:.kah] ‘plumbing’. Moreover, an unstressed vowel in a light penultimate syllable is syncopated if the final syllable, which is stressed, is of the form CVVC; e.g., /b**u**.ˈsˁa:tˁ/ → [ˈbsˁa:tˁ] ‘carpet’. However, syncope is blocked if it creates a non-final CVCC; e.g., /ˈjik.tib -ah/→ [ˈjik.ti.bah] /* [ˈjikt.bah] ‘he wrote it (m. sg.)’. Furthermore, syncope is not motivated by a consonant-initial affix, compared to a vowel-initial affix; e.g., /ri.kab-na/→ [.ri.kab.na.] ‘we rode’. Unstressed short vowels in appropriate environments for syncope do not undergo this process because they are borrowed from SA; e.g., /mu.'di:r/→ [mu.'di:r] /*[mdi:r] ‘ manager’. In terms of the analysis within OT, I presented a set of constraints that could work with the entire cases of syncope.

The unified set of OT constraints in this chapter addressed the question related to the syllable structure processes that can be understood through OT. In other words, the insights about related syllable structure processes like CV metathesis, epenthesis, vowel shortening, and syncope can be analyzed by the unified set of OT constraints below:

(6.2)

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_σ$>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL >> LINEARITY >> SSP>> *CLASH >>WSP>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$ >>*CODA

At the end of this chapter, CV metathesis, vowel epenthesis, and syncope were demonstrated as areas of variations that differentiate NA from UHA. The Unified set of constraints with distinct rankings were used to show the power of OT for accounting for cross-linguistic variations with reference to NA and UHA:

(6.3)

a. NA unified set of constraints:

ONS>>*LLL>>*3μ>>VA>>*[VP>>*CVV.CV]$_σ$>>SYLLCON>>*i]$_σ$>>*LENITION-GUTTURAL >> LINEARITY >> SSP>> *CLASH >>WSP>> No[u]>> No[a]>>MAX-IO>>MAX-μ-IO>>*COMPLEX$_{ONS}$>>O-CONTIG>>DEP-IO >> *COMPLEX$_{CODA}$ >>*CODA

b. UHA unified set of constraints:

ONS>>*COMPLEX$_{ONS}$>>LINEARITY>>*3μ>>VA>>*[VP>>O-CONTIG>>SYLLCON>>*CVV.CV]$_σ$>>*i]$_σ$>>*LENITION-GUTTURAL>>SSP>>*CLASH>>WSP>>MAX-C>>No[u]>>No[a]>>MAX-IO>>MAX-μ-IO>>*LLL>>DEP-IO>> *COMPLEX$_{CODA}$>>*CODA

Appendices

Appendix A: Types of consonant clusters in NA:

Word-initial clusters

Consonant cluster: initial	Input	Output	Translation
/bd-/	/bi.di:r.tah/	[bdi:r.tah]	‘ in his town’
/bk-/	/bi.kee.fah/	[bke:fah]	‘as he likes’
/bg-/	/ba.ga.ra/	[bgara]	‘cow’
/bʕ-/	/bi.ʕi:r/	[bʕi:r]	‘camel’
/bsˤ-/	/bu.sˤa:tˤ/	[bsˤa:tˤ]	‘carpet’
/bʃ-/	/bi.ʃa.ra/	[bʃara]	‘good news’
/bχ-/	/bi.χee.ʃah/	[bχeeʃah]	‘in a sack’
/bħ/	/buħu:r/	[bħu:r]	‘seas’
/br-/	/bi.ridʒ.lah/	[bridʒlah]	‘ on his foot’
/tk-/	/ti.kal.lim/	[tkallim]	‘you (m) are talking to’
/tʁ-/	/taʁaa.mir/	[tʁaamir]	‘you (m) take risks’
/tf-/	/ti.fu:ħ/	[tfu:ħ]	‘you (m) boil/ she boils’
/tθ-/	/ti.θu:r/	[tθu:r]	‘you (m) rage/she rages’
/tsˤ-/	/tu.sˤu:m/	[tsˤu:m]	‘you (m) fast/ she fasts’
/tʃ-/	/tu.ʃu:f/	[tʃu:f]	‘ you (m) see/she sees’
/tʕ-/	/ti.ʕal.lim/	[tʕallim]	‘to inform’
/tm-/	/ti.maθ.θil/	[tmaθθil]	‘you act or he /she acts’
/tl-/	/tu.lu:m/	[tlu:m]	‘ you blame or he/she blames’
/tr-/	/tu.ra:b/	[tra:b]	‘sand’
/dm-/	/du.mu:ʕ/	[dmu:ʕ]	‘tears’
/dl-/	/di.la:.lah]	[dla:lah]	‘brokerage fees’
/tˤb-/	/tˤu.bu:l/	[tˤbu:l]	‘drums’
/kb-/	/ki.ba:r/	[kba:r]	‘huge (pl.)’
/kf-/	/ku.fu:f/	[kfu:f]	‘palms’
/kr-/	/ku.ru:t/	[kru:t]	‘cards’
/gb-/	/gu.bu:r/	[gbu:r]	‘graves’
/gm-/	/gu.ma:r/	[gma:r]	‘gambling’
/gsˤ-/	/gu.sˤu:r/	[gsˤu:r]	‘palaces’
/gʃ-/	/gu.ʃu:r/	[gʃu:r]	‘peel (n)’

/gr-/	/gu.ru:n/	[gru:n]	‘horns’
/kl-/	/kilaab/	[klaab]	‘dogs’
/ʃm-/	/ʃi.ma:ʁ/	[ʃma:ʁ]	‘men’s head-scarf in the Gulf’
/ʃr-/	/ʃu.ru:χ/	[ʃru:χ]	‘fireworks’
/ʤn-/	/ʤu.nu:n/	[ʤnu:n]	‘madness or ghosts’
/ʤl-/	/ʤu.lu:d/	[ʤlu:d]	‘skins’
/ʤr-/	/ʤu.ru:ħ/	[ʤru:ħ]	‘wounds’
/fħ-/	/fu.ħu:l/	[fħu:l]	‘studs’
/fn-/	/fu.nu:n/	[fnu:n]	‘arts’
/fl-/	/filu:s/	[flu:s]	‘money’
/fr-/	/furu:χ/	[fru:χ]	‘chicks’
/ðn-/	/ðu.nu:b/	[ðnu:b]	‘sins’
/ðr-/	/ði.ra:ʕ/	[ðra:ʕ]	‘arm’
/sl-/	/si.la:ħ/	[sla:ħ]	‘weapon’
/zb-/	/zi.ba:.lah/	[zba:lah]	‘trash’
/zl-/	/zu.lu:f/	[zlu:f]	‘sideburns’
/sˤχ-/	/sˤu.χu:r/	[sˤχu:r]	‘rocks’
/ʃg-/	/ʃu.gu:g/	[ʃgu:g]	‘cuts’
/mʃ-/	/mu.ʃu:χ/	[mʃu:χ]	‘scratches’
/χd-/	/χu.du:d/	[χdu:d]	‘cheeks’
/χʃ-/	/χu.ʃu:m/	[χʃu:m]	‘noses’
/hm-/	/hu.mu:m/	[hmu:m]	‘concerns (n)’
/hn-/	/hu.nu:d/	[hnu:d]	‘Indians’
/ħb-/	/ħi.ba:l/	[ħba:l]	‘ropes’
/ħʤ-/	/ħi.ʤa:b/	[ħʤa:b]	‘hijab’
/ħs-/	/ħi.sa:b/	[ħsa:b]	‘account’
/ħz-/	/ħi.za:m/	[ħza:m]	‘belt’
/ħsˤ-/	/ħi.sˤa:n/	[ħsˤa:n]	‘horse’
/ʕðˤ-/	/ʕi.ðˤa:m/	[ʕðˤa:m]	‘bones’
/ʕn-/	/ʕi.na:d/	[ʕna:d]	‘stubbornness’
/mt-/	/mi.ta:n/	[mta:n]	‘fat (pl)’
/mtˤ-/	/mi.tˤah.har/	[mtˤahhar]	‘circumcised or sterilised’
/mg-/	/mi.ga:.bil/	[mga:bil]	‘in front of’
/mf-/	/mi.faw.wir/	[mfæwwir]	‘you (m) are furious/ he is furious’
/mðˤ-/	/mu.ðˤam.mad/	[mðˤæmmad]	‘you (m) are bandaged/he is bandaged’

/ms-/	/mi.saχ.χin/	[msaχχin]	‘you (m) have a fever/he has a fever’
/mz-/	/mi.zaw.wir/	[mzawwir]	‘you (m) have forged/ he has forged’
/mʕ-/	/mi.ʕa:.nid/	[mʕa:nid]	‘being stubborn (n)’
/mn-/	/mu.na:.sib/	[mna:sib]	‘you (m) are related to /he is related to ‘Or ‘appropriate’
/mw-/	/mi.wa:.ʕid/	[mwa:ʕid]	‘you (m) have an appointment/date-he has an appointment/date’
/nχ-/	/naχ.lah/	[nχalah]	‘palm tree’
/nʕ-/	/nu.ʕu:l/	[nʕu:l]	‘shoes’
/ls-/	/li.sa:n/	[lsa:n]	‘tongue’
/lħ-/	/li.ħa:f/	[lħa:f]	‘blanket’
/rf-/	/ru.fu:f/	[rfu:f]	‘shelves’
/rχ-/	/ri.χa:sˤ/	[rχa:sˤ]	‘cheap (pl)’
/rm-/	/ru.mu:ʃ/	[rmu:ʃ]	‘eyelashes’
/sm-/	/si.ment/	[sment]	‘cement
/gh-/	/gah.wa/	[ghawa]	‘coffee’
/ʁn-/	/ʁa.nam-i/	[ʁnimi]	‘my sheep’
/jχ-/	/jaχ.dim/	[jχadim]	‘he serves’
/tχ-/	/taχd.miin/	[tχad.miin]	‘she serves'
/ng-/	/ni.gad.dim/	[ngaddim]	'we offer'
/kt-/	/ki.ta:b/	[kta:b]	'book'
/tʁ-/	/taʁ.ris/	[tʁaris]	'she plants'
/nʕ-/	/naʕ.ʤa/	[nʕaʤa]	'ewe'
/jʁ-/	/jaʁ.ris/	[jʁaris]	'he plants'
/sʔ-/	/saʔ.lat/	[sʔa.lat]	‘she asked’
/zʕ-/	/zaʕ.lat/	[zʕa.lat]	‘she is upset’

Word-final clusters

Consonant cluster: final	Input	Output	Translation
/-nt/	/bint/	[bint]	‘girl’
/-nd/	/ʕind/	[ʕind]	‘It is with…’
/-nʤ/	/banʤ/	[banʤ]	‘anaesthesia’
/-rd/	/bard/	[bard]	‘cold/it is cold’
/-rg/	/barg/	[barg]	‘thunder’
/-fs/	/nafs/	[nafs]	‘similar to’
/-ft/	/ʃift/	[ʃift]	‘rotation’
/-sˤtˤ/	/gasˤtˤ/	[gasˤtˤ]	‘instalment’
/-ʃt/	/biʃt/	[biʃt]	‘bisht is a formal cloak-like dress worn up on the top of thoub (traditional dress) in Saudi Arabia and some Arab counties.
/-ħθ/	/baħθ/	[baħθ]	‘research (n)’
/-ʕθ/	/baʕθ/	[baʕθ]	‘resurrection’
/-lb/	/kalb/	[kalb]	‘dog’
/-lk/	/ʕilk/	[ʕilk]	‘chewing gum’
/-dħ/	/madħ/	[madħ]	‘praising’
/-ʕm/	/daʕm/	[daʕm]	‘support’
/-ʕn/	/tˤaʕn/	[tˤaʕn]	‘stabbing’
/-km/	/lakm/	[lakm]	‘punching’
/-tħ/	/fatħ/	[fatħ]	‘opening’
/-fn/	/dafn/	[dafn]	‘burying’

Appendix B: Results of Applying Recursive Constraint Demotion to The Final OT ranking constraints-chapter4.txt

9-19-2014, 4:29 p.m.

OTSoft 2.3.3

Release date 7/15/2013

Chapter 4. Result

A ranking was found that generates the correct outputs.

Stratum	**Constraint Name**	**Abbreviation**
Stratum #1	ONS	Onset
	*LLL	*LLL
	*3μ	*3μ
	SYLLCON	SYLLCON
	$*i]_{\sigma}$	$*i]_{\sigma}$
	*LENITION-GUTTURAL	*LENITION-GUTTURAL
	*FINAL-G	*FINAL-G
	*FINAL-C-μ	*FINAL-C-μ
Stratum #2	LINEARITY	LINEARITY
	SSP	SSP
	MAX-IO	MAX-IO
	*COMPLEXONS	*COMPLEXONS
Stratum #3	MAX-μ-IO	MAX-μ-IO
	DEP	DEP
Stratum #4	*COMPLEXCODA	*COMPLEXCODA
	*CODA	*CODA

Appendix C: Results of Applying Recursive Constraint Demotion to The Final OT ranking constraints-chapter5.txt

9-22-2014, 3:24 p.m.

OTSoft 2.3.2

Release date 1/10/2013

The results of the evaluations in chapter 4 and 5 were generated using OT software (Hayes, Tesar and Zuraw 2013).

Results: A ranking was found that generates the correct outputs.

Stratum	**Constraint Name**	**Abbreviation**
Stratum #1	ONS	Onset
	*LLL	*LLL
	*3μ	*3μ
	VA	VA
	*[VP	*[VP
	*CVV.CV]$_{\sigma}$	*CVV.CV]$_{\sigma}$
	*LENITION-GUTTURAL	*LENITION-GUTTURAL
	*CLASH	*CLASH
	No[u]	No[u]
Stratum #2	SYLLCON	SYLLCON
Stratum #3	*i]$_{\sigma}$	*i]$_{\sigma}$
	LINEARITY	LINEARITY
	SSP	SSP
	WSP	WSP
Stratum #4	MAX-C	MAX-C
Stratum #5	No[a]	No[a]
	O-CONTIG	O-CONTIG
Stratum #6	MAX-IO	MAX-IO
	MAX-μ-IO	MAX-μ-IO
	*COMPLEXONS	*COMPLEXONS
	*COMPLEXCODA	*COMPLEXCODA
Stratum #7	DEP	DEP
	*CODA	*CODA

Tableaux

Tableau (1)

/ˈgah.wa/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEXONS	MAX-IO	*COMPLEXCODA	DEP	*CODA
☞ μ μ ˈgha.wa											*			*		**			*				
μμ μ ˈgah.wa										*!						*							*
μ μ μ ˈga.ha.wa							*!									***							*
μμ μ ˈgaw. wa		*!																				*	

Tableau (2)

/ˈnaχ.lah/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEXONS	MAX-IO	*COMPLEXCODA	DEP	*CODA
☞ μ μ ˈnχa.lah											*			*		**			*				*
μμ μ ˈnaχ.lah										*!						*							**
μμ μ ˈnaw. lah							*!									*							**
μ μ μ ˈna. χa. lah		*!														***						*	*

Tableau (3)

/ˈkti.ʃaf/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ μ ☞" ˈ ʔik.ti.ʃaf												*				*						**	**
μ μ ˈkti.ʃaf					*!						*					*			*				*
μ μ μ ˈki.ti.ʃaf		*!										*				*	*					*	*
μμ μ μ ik.ti.ʃaf	*!											*				*						*	**

Tableau (4)

/ˈskin/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ ☞ˈʔis.kin																						**	**
μμ ˈskin											*!								*				*
μ μ ˈsi.kin																	*!					*	*
μμ μ ˈis.kin	*!																					*	**

Tableau (5)

/ˈti.da.ris/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ μ ☞ ˈʔid.da.ris																		*		*		**	**
μ μ ˈtda.ris																		*	*!	*			*
μ μ ˈdda.ris											*!					*		*	*	*			*
μ μ μ ˈti.da.ris		*!															*					*	*

Tableau (6)

/ˈsˤabr/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μ μ ☞ ˈsˤa. bur																*	*			*		*	*
μμ ˈsˤabr											*!										*		**
μμ μ ˈsˤab. ru												*!										*	*
μμ ˈsˤab															*!		*			*			*

Tableau (7)

/ˈgarʃ/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ ☞ ˈgarʃ																					*		**
μ μ ˈga.riʃ																*!	*					*	*
μμ μ ˈgar.ʃi												*!										*	*
μμ ˈgar															*!		*			*			*

Tableau (8)

/ˈbe:.t_{μ}-na_{POSS} /	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ ☞ ˈbe:t. na										*						*							*
μμμ μ ˈbe:t. na			*!							*						*						*	*
μμ μ μ ˈbe:.ti. na						*!										*						*	
μμ μ ˈbet. na										*						*		*!		*			*

Tableau (9)

/ˈbin.t$_{\mu}$-na$_{\text{POSS}}$ /	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{\text{ONS}}$	MAX-IO	*COMPLEX$_{\text{CODA}}$	DEP	*CODA
μμ μ μ ☞ ˈbin.ti. na												*				*						*	*
μμμ μ ˈbint. na			*!							*						*					*		**
μμ μ ˈbint.na										*!						*					*		**
μ μμ μ ˈbi.nit. na										*!						*	*						*

Tableau (10)

/ˈʤa:.b_{μ}-l_{μ}-i/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
☞ μμ μ ˈʤa:b.li										*		*											*
μμμ μ ˈʤa:b.li			*!							*		*											*
μμ μ μ ˈʤa:.ba.li						*!						*										*	
μμ μ ˈʤab.li										*		*						*!		*			*

Tableau (11)

/ˈʤa:.b$_{\mu}$-l$_{\mu}$-hum/	ONSET	*LLL	*ʒμ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μ μμ μ ☞ ʤa.ˈbil. hum									*							*	*					*	**
μμ μ μ ˈʤa:b.li.hum									*	*!													**
μμ μ μ μ ˈʤa:.ba.la.hum		*!							*							**	*					**	*

Tableau (12)

/ˈgil.t$_{\mu}$-l$_{\mu}$-i/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ μ ☞ ˈgil.ti. li												**										*	*
μμ μ ˈgilt. li										*!		*									*		**
μμμ μ ˈgilt. li			*!									*									*		**
μ μμ μ gi.ˈl i t. li										*!		*					*			*		*	*

Tableau (13)

/ˈgil.t$_{\mu}$-l$_{\mu}$-hum/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ μ ☞ ˈgil.ti. hum									*			*										*	**
μμ μ μ ˈgilt. li.hum									*	*!		*									*	*	***
μμμ μ μ ˈgi l t. li.hum			*!						*	*		*									*	*	***

Tableau (14)

/ˈgil.t$_{\mu}$-l$_{\mu}$-hum/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ μ ☞ ˈgil.ti. hum									*			*										*	**
μμ μ μ ˈgilt. li.hum									*	*!		*									*	*	***
μμμ μ μ ˈgi l t. li.hum			*!						*	*		*									*	*	***

Tableau (15)

/ˈga:.l_{μ}-na_{SUB}/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ ☞ g i l. na										*						*		*		*			*
μμμ μ ga:l.na			*!							*						*							*
μ μ μ ga l.na				*!						*						*		*		*			*

Tableau (16)

/ra:.ħ$_{\mu}$-l$_{\mu}$-hum$_{OBJ}$/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μ μμ μ ☞ ra.ˈħil.hum									*			*				*	*	*		*		*	**
μμμ μ μ ˈra:.ħ.li.hum			*!						*	*		**										*	**
μμ μμ μ ra:.ˈħil.hum									*			*	*!				*					*	**

Tableau (17)

/ˈʃaː.ˈriʕ.ha$_{OBJ}$/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_σ$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
☞ μ μμ μ ʃa.ˈri ʕ.ha																**		*		*			*
μμ μ μ μ ˈʃaː.ˈr i ʕ. ha								*!								*							*
μμ μμ μ ʃaː.ˈriʕ. ha													*!			*							*

Tableau (18)

/ˈħam.ˈraːʔ/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_{\sigma}$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_{\sigma}$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μ μ μ ☞ ˈħam.r a										*					*	*		*		*			*
μ μ μμ ˈħam.r aː										*			*!		*					*			*
μ μ μ μ ˈħam.ˈr aːʔ								*!		*													**
μ μ μ μ ˈħam.r aːʔ										*			*!										**

Tableau (19)

/ˈsa.rag-u$_{\text{OBJ}}$/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{\text{ONS}}$	MAX-IO	*COMPLEX$_{\text{CODA}}$	DEP	*CODA
μ μ ☞ ˈsri.gu									*			*						*	*	*			
μ μ ˈsru.gu									**!			*						*	*	*			
μ μ ˈsra.gu									*			*				*!		*	*	*			
μ μ μ ˈsa.ra.gu		*!							*			*				**							

Tableau (20)

/ˈʃa.ʤa.ra/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_σ$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μ μ ☞ ˈʃʤa.ra																**		*	*	*			
μ μ μ ˈʃaʤ.ra										*!						*		*		*			*
μ μ μ ˈʃa. ʤa.ra		*!														***							

Tableau (21)

/zi.ˈra:.ʕah/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ ☞ ˈzra:.ʕah																*		*	*	*			*
μ μμ μ zu.ˈra:.ʕah									*!			*				*							*
μ μμ μ za.ˈra:.ʕah																**!							*
μ μμ μ zi.ˈra:.ʕah												*!				*							*

Tableau (22)

/ti.ˈmaθ.θil/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_σ$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_σ$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
μμ μ ☞ ˈtmaθ.θ i l																		*	*	*			**
μ μμ μ ti.ˈmaθ. θi l												*!											**
μ μμ μ tu.ˈmaθ. θi l									*!			*											**
μ μμ μ ta.ˈmaθ. θi l																*!							**

Tableau (23)

/ˈði.ˈra:ʕ/	ONSET	*LLL	*3μ	VA	*[VP	*CVV.CV]$_\sigma$	*LENITION-GUTTURAL	*CLASH	No[u]	SYLLCON	SSP	*i]$_\sigma$	WSP	LINEARITY	MAX-C	No[a]	O-CONTIG	MAX-μ-IO	*COMPLEX$_{ONS}$	MAX-IO	*COMPLEX$_{CODA}$	DEP	*CODA
☞ μμ ˈðra:ʕ																		*	*	*			*
μ μμ ði.ˈra:ʕ												*!											*

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