TOPICS IN THE PHONONLOGY OF NORTHERN NAJDI ARABIC: AN OPTIMALITY-THEROETIC ANALYSIS

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN THEORETICAL LINGUISTICS

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Newcastle University, UK

January 2023

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Declaration

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DEDICATION

With love and gratitude,

I dedicate this thesis to my parents,

To my wife and children,

To my brothers and sisters

ACKNOWLEDGEMENTS

All praise is due to Almighty Allah for assisting and providing me with strength, patience, countless blessings, and persistence to complete this thesis and achieve my goals. I can never thank Allah enough for the countless bounties He has bestowed upon me.

After Almighty Allah, this work could not have been completed without the help, support, and guidance of so many individuals during my PhD years.

I am deeply indebted to my supervisors, Dr Rory Turnbull and Dr Gary Taylor-Raebel, for their continuous support, perfect guidance, and utter patience throughout all stages of developing this thesis at Newcastle University. I would like to express my sincere appreciation to Dr Gary Taylor-Raebel for his insightful feedback and profound knowledge in the field of phonology, especially in shaping my research interests and thesis topic at the early stages of this work. Dr Rory Turnbull was a true mentor and a role model to me. He has always been there for me, especially in difficult times, providing me with endless support, insightful comments, and productive discussions. It was undoubtedly a privilege to have you as my main supervisor. Special thanks are also extended to my co-supervisor, Professor Martha Young-Scholten, for her incredible inspiration and invaluable encouragement. My dear supervisors, this work would not have seen the light without you.

I would like to express my heartfelt gratitude to the members of the annual progress review panel for their wonderful comments and advice: Professor Andres Holmberg, Dr Christina Cuskley, Dr Johannes Heim, and Dr Guilherme Duarte Garcia. Great thanks are also due to the faculty members and administrative staff in the school of English Literature, Language, and Linguistics at Newcastle University for providing me with essential training and kind assistance during the module phase, particularly Professor Andres Holmberg, Dr SJ Hannahs, Dr Gary Taylor-Raebel, Callum Hackett, Dr William van der Wurff, and Scott Burdon.

My deepest thanks also go to my internal and external examiners, Dr Niamh Kelly and Professor Janet Watson for their constructive comments and effective discussions on my thesis.

My thanks are also extended to my postgraduate fellows and friends at Newcastle University for their support. I particularly acknowledge Dr Saleh Alazmi, Dr Metab Alhoody, and Dr Naif Alshammari. I strongly pass my warm thanks and uttermost gratitude to the Northern Najdi

Arabic speakers whom I consulted about Northern Najdi data. Special thanks go to Dr Wafi Alshammari, Khulaif Alshammari, and Sultan Alshammari for their relentless support and help.

To my great parents, no words can fully express my sincere appreciation and gratitude towards you. Your unconditional love, continued prayers, and endless support have always been a source of strength, happiness, and inspiration throughout my PhD journey and in my entire life. I wish you a long healthy life, and I pray to Almighty to reward you with the eternal paradise.

Finally, to my small family, words are just here to express how I feel, but the feeling itself goes beyond and above my words. I owe the greatest debt of gratitude to my lovely wife, Manal Alshammari, for her sacrifice, understanding, unstinting patience, and unwavering devotion during my study. Without you, Manal, I would not have been able to discover the joy of life during those difficult days; I am forever indebted to you. To my beloved daughters, Kholoud, Ghand, and Aljawharah, I apologise for sacrificing the valuable time I could have spent with you over the course of my study. You are the most precious gift God has given me in this life, my joy and happiness. May God bless you, my angels!

ABSTRACT

This thesis explores selected topics in the phonology of Northern Najdi Arabic (NNA), a dialect spoken in the region of Ḥā'il in Saudi Arabia, and provides a formal analysis within the framework of Optimality Theory (OT). Although this variety of Arabic has been briefly studied from a descriptive perspective by Abboud (1979), the selected topics have never undergone a formal analysis before. This study has two broad goals. The first is to enrich the literature, not only in terms of linguistic theory but also the field of Arabic dialectology, by presenting a range of new data from NNA that linguists have access to. The second is to enhance the field of Arabic phonology by investigating various phonological processes and analysing them through current phonological theories. To reach this goal, the current study describes the major phonological generalisations of NNA, focusing on syllable structure and syllabification patterns, consonant clusters, and stress assignment and foot construction.

The current study is comprised of six chapters. The first chapter provides some preliminaries, a background to NNA, and a general introduction to the current study. The second chapter introduces the main phonological theories that are implemented in the analysis of the phonological phenomena throughout the thesis. The third chapter offers a comprehensive discussion and analysis of the syllable structure and syllabification patterns in NNA under Moraic Theory, with special attention given to the treatment of superheavy syllables word-internally and finally. The fourth chapter presents the formation of consonant clusters in tautosyllabic and heterosyllabic contexts. It also focuses on the ban of some initial and final consonant clusters and the internal triconsonantal clusters that are subject to certain restrictions and phonological processes, such as the Obligatory Contour Principle, the Sonority Sequencing Principle, and vowel epenthesis. The fifth chapter provides a detailed description and analysis of transparent stress assignment and foot construction in NNA under Metrical Stress Theory. The final chapter summarises all of the chapters, concentrating on the main findings of the current study and laying out some recommendations for future studies.

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LIST OF SYMBOLS AND ABBREVATIONS

CA	Classical Arabic
CL	Compensatory Lengthening
cf.	confer (compared to)
C	consonant
C1	first member of a consonant cluster
C2	second member of a consonant cluster
c:	long consonant (geminate)
[ł]	dark /l/
ERR	End Rule Right
EVAL	Evaluation
e.g.	exempli gratia (for example)
Fem.	Feminine
Ft	foot
FtBin	foot binary
G	geminate
GEN	generator
IO	Input/Output
→	leads to
Mas.	Masculine
MSD	Minimal Sonority Distance
μ	mora
NA	Najdi Arabic
NNA	Northern Najdi Arabic
Nom.	Nominative
Nuc	Nucleus or nuclei
OT	Optimality Theory
OCP	Obligatory Contour Principle
💣	wrong output selected as optimal
☞	optimal candidate
Pl.	Plural
PrWd	Prosodic Word
ω	Prosodic/Phonological Word

< >	represents extrametrical segment or extrasyllablicity
[ ]	represents phonetic transcription (surfacing form)
/ /	represents phonemic transcription (underlying form)
#	word boundary
1st p.	first-person
2nd p.	second-person
Sg.	singular
SSP	Sonority Sequencing Principle
SPE	Sound Pattern of English
SLH	Strict Layering Hypothesis
Syll	Syllabic
SCL	Syllable Contact Law
X	timing slot which refers to any segment
x	stressed syllable in stress representation
σ	syllable
'	stress
.	syllable boundary/break
*****	ungrammatical form
.	unstressed syllable in stress representation
v	vowel
v:	long vowel
WBP	Weight-By-Position
WSP	Weight-to-Stress

Chapter 1. Preliminaries

1.1 Introduction

Studies on different Arabic dialects have led to a flourishing amount of literature not only in linguistic theory in general but also in the field of Arabic dialectology in particular. Such studies have contributed towards the field of phonology by providing a range of data that linguists have access to. These data can better assist phonologists to develop current and future phonological theory in relation to different languages and dialects. For instance, research has investigated different phonological and morphophonological aspects of diverse Arabic dialects. Such aspects may include syllable structure and syllabification patterns, vowel epenthesis and syncope, emphasis spread, and stress assignment. Some of the well-studied Arabic dialects that have contributed to Arabic phonology include Lebanese Arabic (Haddad 1984), Jordanian Arabic (Sakarna 1999), San'ani and Cairene Arabic (Watson 2002), Hadhrami Arabic (Bamakhramah 2009), Sudanese Arabic (Ali 2014), Southwestern Saudi Arabic (Alahmari 2018), and Northwestern Saudi Arabic (Alhawaykim 2018).

Saudi Arabia is one of the main countries in the Arabian Peninsula and holds a large number of dialects that exhibit a great deal of linguistic variation (Prochazka 1988). However, the northern part of the Najdi region in Saudi Arabia lacks a phonological study of its dialects and other linguistic feature classification. The current study investigates one of the Arabic dialects spoken in Hail Province by members of the Shammar tribe, based in the north of the Najd region of Saudi Arabia. It should be emphasised that I have chosen NNA because I am a native speaker of this dialect. Fundamentally, this study investigates and provides a description of selected topics in relation to the phonology of Northern Najdi Arabic (henceforward NNA) in light of Optimality Theory (OT). To be more specific, this thesis sheds light on syllable structure and syllabification patterns in the dialect, the treatment of final and non-final superheavy syllables to maintain the bimoraicity status, and permissible and impermissible consonant clusters. Moreover, the present study investigates word stress assignment and foot construction in NNA.

It should be highlighted that this thesis provides a formal analysis within the framework of Optimality Theory. This framework is used as an alternative method to a rule-based model to analyse various linguistic features in the grammar of NNA. The proposed OT constraints determine the relationship between underlying forms and their surface forms. I adopt this theory to analyse NNA data for two major reasons. First, OT is a declarative theory because all constraints belong to the output or to both the input and output in combination, and it expresses diverse relationships and tendencies within one phonological process. Second, OT has the ability to tackle and provide better understanding of such phonological conspiracies related to the syllable and further in one representation (Davenport and Hannahs 2010). For instance, in OT, we can integrate different information that is relevant to stress assignment; information about phonological and morphological structure of the constituents, the rhythmic organisation, and weight, in which this information is deemed as conflicting forces. These forces are expressed by violable universal constraints that specify the distribution of stressed and unstressed syllables in the word, not only in one language but in most languages.

The rest of this introductory chapter constitutes six main sections as follows: section 1.2 offers a brief background on NNA. Section 1.3 introduces the phonemic inventory including the consonantal and vocalic systems in the language. Section 1.4 discusses the significance and contribution of the current research. Section 1.5 lays out the main research questions that need to be addressed throughout the thesis. Section 1.6 illustrates the source of the data in this thesis along with some general notes. Section 1.7 outlines the organisation of the remaining chapters in this work. Finally, section 1.8 concludes the chapter.

1.2 Northern Najdi Arabic: Background

The Najd region lies in the centre of the Arabian Peninsula. The region has diverse dialects labelled as Najdi dialects that are spoken by more than 10,000,000 speakers (Al-Sweel 1990). These varieties are informally used in everyday communication, but not in education or in a written setting. Northern Najdi Arabic is a variety of Saudi Najdi Arabic, spoken in the northern areas of the Najd province in the Arabian Peninsula. The current study aims to investigate Hāʼili Arabic, a variety of Najdi Arabic that is typically spoken b1y people living in Hāʼil city and its surroundings and is ascribed to the Shammar tribe. According to Prochazka (1988), the Shammari dialects of the north are considered a subgroup among the Najdi dialects, represented by the Hāʼili dialect and its surroundings. Despite this, Najdi Arabic is not merely one dialect as it belongs to a large number of cultural groups who speak more than one variety, all of which fall under what is called the Najdi dialects.

Ingham (1994) posited that the area of Najd is geographically wide, but people are culturally analogous to a large extent. These populations can be divided into three broad subgroups as follows:

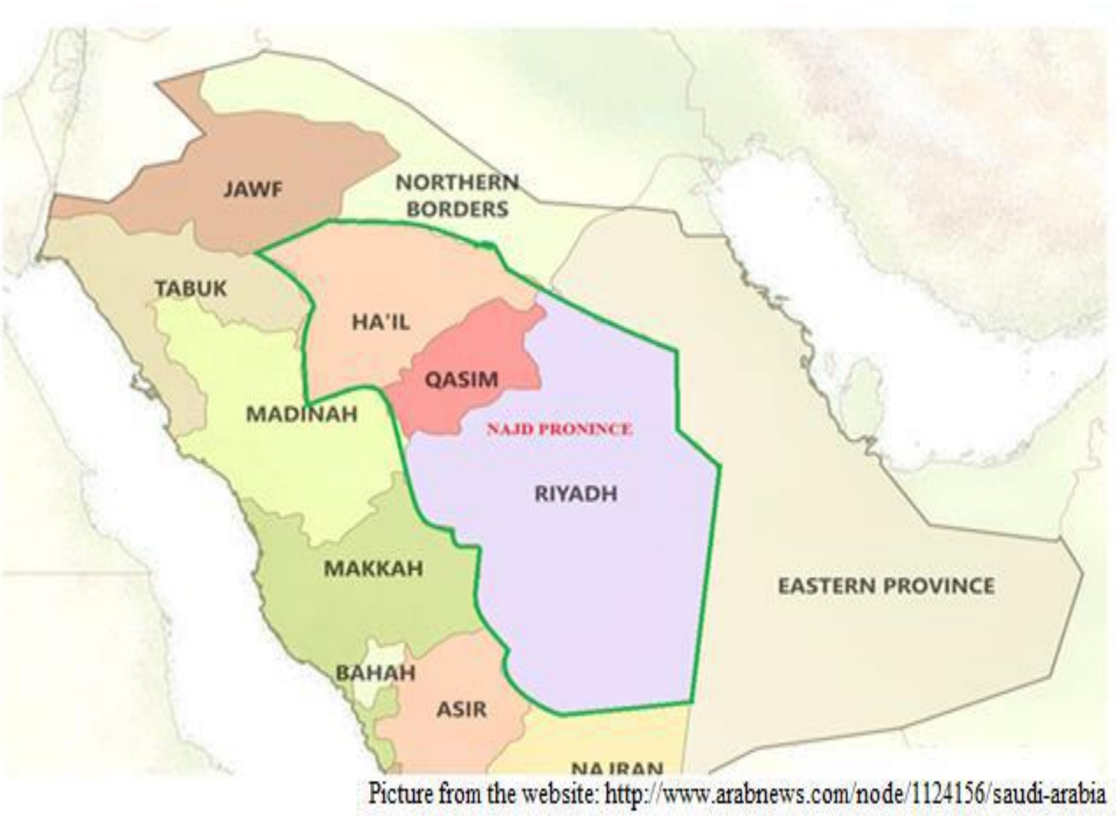
1. 'The speech of the sedentary population of the areas of Central Najdi (i.e., the districts of al-Ārid, al-Washm and Sudair), of Qasim and Jabal Shammar to the north and Najran and Bisha to the south'.
2. 'The speech of the main bedouin tribes of those regions, i.e., 'Anaizah, 'Utaiba, Subai', Suhūl, Bugūm, Dawāsir, Harb, Mutair, 'Awāzim, Rashāyidah in the center, Shammar and Dhafir in the north and Ghatān, Al Murra and 'Ajmān in the south and east'.
3. 'The speech of the emigre Bedouin tribes of the Syrian desert and the Jazirah of Iraq of Anizah and Shammar extraction' (Ingham 1994: 4).

Based on the general linguistic features, (Ingham 1994) classified Najdi dialects into four sub-dialects as follows:

1. 'Central Najdi: The dialects of central Najd as described above and the central Bedouin tribes also the 'Anizah of the Syrian desert.'
2. 'Northern Najdi: The dialect of Jabal Shammar tribes and of the Shammar tribes of Northern Najd and the Aljazirah.'
3. 'Mixed Northern-Central: The dialect of Qasīm and of the Dhafīr tribe.'
4. 'Southern: The dialect of Najrān and the Ghatān tribe of the south and of the Āl Murrah and 'Ājmān tribes to the east' (Ingham 1994: 5).

Consider figure (1) for a map of the Najdi province marked by green, illustrating where Northern Najdi represented by Hā'il is located.

Figure 1: Najd Province Map



(Adapted from Alazmi 2019: 4)

According to (Ingham 1994), the four sub-dialects above differ from each other in various linguistic levels. The main differences between the central and northern dialects are their phonological and morphological characteristics. Moreover, southern dialects are distinguished by syntactic and lexical features, specifically those found in Yemen. In this thesis, the main concentration is on certain phonological phenomena of Northern Najdi Saudi Arabic spoken in Hā'il city and its surroundings by members of the Shammar tribe, rather than Najdi Arabic as a whole, since the author is a native speaker of NNA.

1.3 Phonemic Inventory of NNA

In this section, I will introduce the consonantal and vocalic inventories in the language. NNA has a rich consonantal system, in particular by having uvular, pharyngeal, and pharyngealised consonants, but a limited vocalic system (Watson 2002, Holes 2004). It should be mentioned that NNA has similar consonantal and vocalic systems to most Najdi varieties. In what follows, a general description of the NNA consonants is given in subsection 1.3.1 based on the place and manner of articulation, and this is followed by the NNA vowels in subsection 1.3.2.

1.3.1 Consonantal Phonemes

The Najdi Arabic consonantal system differs slightly from that of Classical Arabic (CA) with regard to the place and manner of articulation and other features. Table (1) below shows the consonant inventory of NNA, where voiceless consonants are illustrated on the left side of each column and those of voiced ones are illustrated on the right side (Alsweel 1981).

Table 1: Consonantal Inventory of NNA

Place of Articulation / **Manner of Articulation**	**Bilabial**	**Labio-dental**	**Dental**	**Alveolar**	**Postalveolar**	**Palatal**	**Velar**	**Uvular**	**Pharyngeal**	**Glottal**
Stop	b			t d tˤ			k g	q		ʔ
Nasal	m			n						
Affricate				ts dz	ʤ					
Fricative		f	θ ð ðˤ	s z sˤ	ʃ			χ ɣ	ħ ʕ	h
Tap/Trill				r						
Lateral				l						
Glides	w					j				

Based on the table of consonant inventory above, there are twenty-eight consonants found in NNA. That is, NNA shares most consonants with their counterparts in CA (Ingham 1994: 12-14). These consonants are classified into diverse manners of articulations as follows: eight stops /b/, /t/, /d/, /tˤ/, /k/, /g/, /q/, and /ʔ/, two nasals /n/ and /m/, three affricates /ʤ/, /ts/, and /dz/, thirteen fricatives /f/, /θ/, /ð/, /ðˤ/, /s/, /z/, /sˤ/, /ʃ/, /χ/, /ɣ/, /ħ/, /ʕ/, and /h/, one tap /r/, one lateral /l/, and two glides /w/ and /j/. However, it can be noted that some NNA consonants and their features are merged into another sound or not found compared to CA. The common consonants or features will be outlined as follows:

First, most of the emphatic and non-emphatic sounds, or what is called gutturals, in NNA have counterparts in CA. The emphatic gutturals are /tˤ/, /ðˤ/, and /sˤ/, and the non-emphatic gutturals are /χ/, /ɣ/, /ħ/, /ʔ/, /ʕ/, and /h/. However, the alveolar emphatic voiced stop /dˤ/ is found in CA but not in NNA. To clarify, the pharyngealised voiced alveolar stop /dˤ/ is realised as the pharyngealised voiced dental fricative /ðˤ/ in the language. For instance, the CA word /**dˤ**arab/ 'hit' surfaces as [**ðˤ**a.rab] in NNA by changing /dˤ/ into [ðˤ]. Thus, the phoneme /dˤ/ is completely absent in the grammar of NNA.

Second, the voiced velar stop /g/ is the reflex of the CA voiceless uvular stop /q/ in NNA, such as in /**q**amar/ 'moon', which surfaces as [**g**i.mar]. However, the same sound alternation between /q/ and /g/ is not found in words borrowed from CA[1], such as /θaqa:fa/ 'culture' and /qara:r/ 'decision', which are realised the same in NNA [θa.qa:.fah] and [qa.ra:r].

Third, another aspect of NNA is the absence of the glottal stop [ʔ] in word-medial and final positions, apart from in words borrowed from CA, such as /qurʔa:n/ 'holy Qura'an' and /taʔθi:r/ 'effect', which surface as [qur.ʔa:n] and [taʔ.θi:r]. The medial glottal stop is replaced by the long low vowel /a:/; for example, /ka**ʔ**s/ 'cup' is changed to [k**a:**s] and /fa**ʔ**r/ 'mouse' is realised as [f**a:**r]. In a word-final position, the glottal stop is always preceded by either a long or a short vowel. When the glottal stop is preceded by a short vowel, the final glottal stop is deleted, and the short vowel is retained, such as in /naba**ʔ/** 'news', which is realised as [ni.ba]. However, if the vowel preceding the word-final glottal stop is long, the glottal stop deletion triggers vowel shortening, such as in /sˤaħr**a:ʔ/** 'desert', which is realised as [sˤaħ.ra].

Fourth, the alveolar /r/ is realised as a tap in NNA. However, this segment is realised as a trill when it is geminated or occurs in a word-final position, such as in [ʤa**r:**a:ħ] 'surgeon' and [ʤa:**r**] 'neighbour'.

Ultimately, an intriguing phonological feature found in NNA is the affrication or lenition[2] of the voiceless and voiced velar stops /k/ and /g/. To clarify, in fronting environments most of the time, [ts] and [dz] are allophones of the phonemes /k/ and /g/ in NNA, respectively. The voiceless alveolar affricate [ts] and the voiced alveolar affricate [dz] usually occur as allophonic variations in the contiguity of short and long front vowels, such as in /mi**k**a:n/ 'place', which

[1] It cannot be generalised that the /q/ is retained in the surface form in all borrowed words from CA because some older speakers change /q/ into [g], even though the word is borrowed from CA.

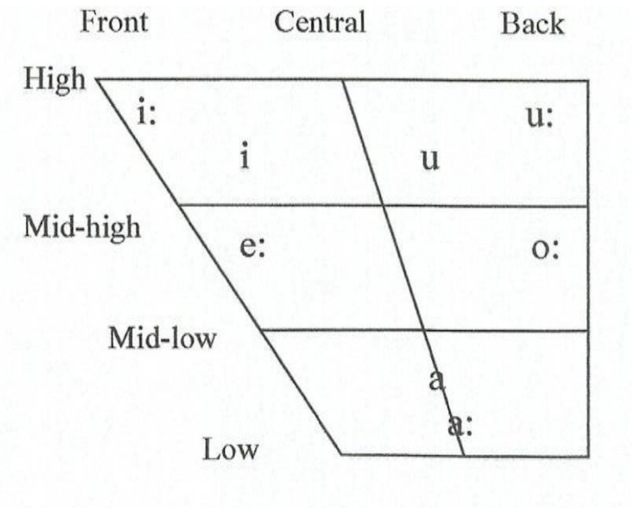
[2] For more information about affrication and lenition in Najdi Arabic, read (Johnstone 1967, 1967b, Ingham 1994, AL-Rojaie 2013).

surfaces as [mi.**ts**a:n], /ke:f/ 'how', which surfaces as [tse:f], and /θi**g**i:l/ 'heavy', which surfaces as [θi.**dz**i:l] (cf. Johnstone 1963, 1967, Ingham 1994, AL-Rojaie 2013).

1.3.2 Vocalic Phonemes

Unlike consonants, the vocalic inventory is simple in CA as well as in NNA. It is noteworthy to mention that CA have six vowels: three short vowels /i/, /u/, and /a/, and their long counterparts /i:/, /u:/, and /a:/, and two diphthongs /aj/ and /aw/. The vowel system of NNA is similar to the vowel system of CA to a large extent. More specifically, NNA has three short vowels and five long vowels. Consider the following diagram showing the vowel system in NNA:

Figure 2: Vowels in NNA (Johnstone 1967, Ingham 1994)



As shown in figure (2), the vowel system in NNA consists of eight vowels: three short vowels /i/, /u/, and /a/, and five long vowels /i:/, /u:/, /a:/, /e:/, and /o:/. These vowels can be distinguished by certain major parameters: high vs. mid-high vs. mid-low vs. low and front vs. central vs. back. To clarify, the vowels /i/ and /i:/ are high front vowels, whilst the /e:/ is a mid-high front vowel. The vowels /a/ and /a:/ are low central vowels, and the vowels /u/ and /u:/ are high back vowels, whilst the /o:/ is a mid-high back vowel. It should be noted that NNA has two purely colloquial monophthong vowels /e:/ and /o:/, which surface only as long. These long vowels correspond to CA diphthongs /aj/ and /aw/, as found in many contemporary Arabic dialects including Abha Saudi Arabic and Jordanian Arabic (cf. Nakshabandi 1988, AbuAbbas 2003). To explain, the vowel /e:/ is a front long vowel that corresponds to /aj/, as in /bajt/ 'house', which is rendered as [be:t] in NNA, and the back long rounded vowel /o:/ corresponds to /aw/, as in /sˤawɣ/ ‘jewelry’, which is rendered as [sˤo:ɣ] in NNA (Johnstone 1967). The following table (2) summarises the NNA vowels with examples, as shown below:

Table 2: NNA Short and Long Vowels

Short	Long	Examples	Gloss
/i/	/i:/	[ka:.t**i**b] - [mu.d**i:**r]	writer (mas. sg.) - manager
/u/	/u:/	[m**u**.ʕal.lim] - [dʒs**u:**r]	teacher - bridges
/a/	/a:/	[b**a**rd] - [n**a:**m]	cold - slept
--	/e:/	[l**e:**l]	night
--	/o:/	[f**o:**g]	over

1.4 Significance of the Study

It should be noted that historically, phonological studies of most peninsular Arabic varieties are exceedingly rare compared to other Arabic dialects, such as San’ani, Lebanese, Cairene, Syrian, and Jordanian Arabic, which have been studied by some scholars including Broselow (1976), Haddad (1984), Zawaydeh (1999), Adra (1999), Watson (2002), Abu-Abbas (2003), and others. More specifically, Saudi Arabic varieties[3] have not received much attention in the realm of phonology except in a few early and recent studies of Hejazi Arabic, including those of Bakalla (1979), Al-Mozainy (1982), Abu-Mansour (1987), Al-Mohanna (1998), Kabrah (2004), Bamakhramah (2009), and Aljarrah (2013). Najdi Arabic (NA) and its subdialects are less-investigated Arabic varieties and have not received a great deal of attention in linguistic domains, such as in the field of phonology within OT in general. To clarify, Johnstone (1963, 1967) and Ingham (1982) investigated affrication in NA and the syllabification processes in the Aniza tribe dialect. Al-Sweel (1987, 1990) discussed the motivation of vowel raising and lowering in NA. Alghmaiz (2013) concentrated on the creation of initial consonant clusters and the effect of Sonority Sequencing Principle in NA. Alshammari and Davis (2019) investigated the occurrence of a morphological augmentative and how diminutive and augmentative forms are phonetically realised with different syllable structures in Ha’ili Arabic (cf. Assuwaida 1997). However, although these previous studies provided a comprehensive descriptive analysis of certain phonological and/or morphonological aspects of Najdi Arabic and its

[3] Saudi dialects include Hejazi, Southern, Najdi, Eastern, and their sub-dialects.

subdialects, they did not analyse these processes from a theoretical perspective, such as using the framework of Optimality Theory. More recent studies in NA were undertaken by Alezetes (2007) and Alqahtani (2014). Alezetes addressed the acquisition of English syllable structure by Najdi native speakers. Alqahtani studied central Najdi spoken in the capital city of Saudi Arabia and its surrounding cities, focusing on syllable structure and other related processes within the OT approach. This latter study provided a brief introduction to various phonological and morphonological processes in NA. For instance, it investigated consonant clusters at word edges and how they are affected by the Sonority Sequencing Principle (SSP). Additionally, the study discussed only the basic stress system in NA following the general rules of Standard Arabic stress. Hence, it can be seen as a foundational work that illustrated the need for further study of other Najdi Arabic variations.

To the best of my knowledge, no previous study of NNA has considered syllable structure and syllabification patterns, the treatment of final and non-final superheavy syllables CVVC, CVCC, and CVVG, and other related phenomena within OT. Nor the licit and illicit complex consonant cluster in tautosyllabic and heterosyllabic contexts. Moreover, stress assignment and foot construction have not received any attention in relation to NA, including NNA. Accordingly, the current study attempts to enhance and contribute to current Arabic linguistic research in general and to the phonology of NNA in particular. This broad goal is accomplished by providing a formal analysis of various phonological aspects for new phonological data in the framework of OT and other related theories. Also, studying such phonological processes will enrich the linguistic body of research on Arabic dialectology by exploring and examining an understudied Northern Najdi Saudi Arabian dialect that has never been the subject of linguistic analysis under OT before. Finally, the current study may be considered the starting point for further studies on different phonological phenomena of the investigated dialect.

1.5 Research Questions

According to the current research on selected topics in the phonology of NNA, this study will seek to address the following main research questions:

1. How are superheavy syllables treated word-internally and word-finally in order to avoid trimoraicity?
2. How does NNA prosodically distinguish between CVC, CVG, and CVCC syllables?
3. How are word edge clusters formed?
4. Does the Sonority Sequencing Principle play a role in forming word edge clusters in NNA?
5. Why and how are certain word edge clusters avoided?
6. How is stress assigned and how are feet constructed in NNA?

The remainder of this thesis is dedicated to investigating and accounting for these main questions from a phonological perspective, couched with the traditional framework of Optimality Theory (Prince and Smolensky 1993/2004, Kager 1999, among others), Moraic Theory, Metrical Stress Theory (Hyman 1985, McCarthy and Prince 1986, Hayes 1989, 1995), along with other relevant approaches and principles. The main assumptions and approaches are offered in the subsequent chapter.

1.6 Notes on Data

The presented data throughout this thesis derive from Northern Najdi Arabic, particularly from Hāʼil city and surrounding areas by members of the Shammar tribe, unless otherwise indicated with direct reference. If no reference is provided, the data stem from the author's own intuition, being a native speaker of NNA. To ensure data reliability and validity, all data have been discussed with and checked by several native speakers of the dialect. All have lived their entire life in the Hāʼil region, ensuring that they have not been affected by other contemporary Arabic dialects. The targeted informants were five females and five males of Northern Najdi Arabic whose age ranged between twenty years and thirty-seven years. Regarding their educational level, most of the participants hold bachelor's degrees, except for two, one master's degree and the other PhD, in different majors. The original or cited data are transcribed using the International Phonetic Alphabet (IPA), (NNA segments are presented in Table 1 and Figure 1).

More to the point, double consonants (geminates) and long vowels are transcribed with a colon as the geminate [d:] and the long vowel [a:], respectively.

1.7 Organisation of the Thesis

The remainder of this thesis is structured as follows. Chapter Two is intended to introduce the significance of the syllable in phonological theory and review relevant phonological theories and models to describe and analyse the phonological phenomena in NNA throughout the thesis. This chapter includes a brief introduction to Optimality Theory, which is the main theoretical framework implemented in the analysis of the current study. Chapter Three is devoted to providing syllable types and their distributions in both CA and NNA. It also addresses the syllabification patterns in NNA, with special attention paid to superheavy syllables. It tackles the issues of how and why some superheavy syllables are avoided. Chapter Four introduces the formation of consonant clusters in tautosyllabic and heterosyllabic contexts. It also accounts for the ban of some initial and final consonant clusters and the formation of internal triconsonantal clusters. Some of these clusters are subject to certain restrictions and phonological processes, such as the Obligatory Contour Principle, the Sonority Sequencing Principle, and vowel epenthesis. Chapter Five provides a detailed description and analysis of how transparent stress is assigned and how feet are constructed in NNA under Moraic Theory and Metrical Stress Theory. It should be emphasised that each chapter develops an Optimality-Theoretic analysis in a separate section to account for the phonological processes under consideration. Chapter Six summarises the main findings of the study and considers the research questions that are addressed throughout the thesis. It also offers a conclusion and provides some recommendations for future research.

1.8 Conclusion

This chapter started by presenting the essential preliminaries of the whole thesis. The introduction section was followed by a general background to the language. Light was then shed on the phonemic inventory by introducing and describing the consonants and vowels found in NNA. The significance of the study was given in section 1.4, with a discussion on how the current study will contribute to the field of phonology in general and to Arabic dialectology in particular. After this, the main research questions that are scrutinised throughout the thesis were presented. The sources of data utilised in this study were then mentioned. Finally, an outline of how the thesis is organised was provided.

Chapter 2. Theoretical Background

2.1 Introduction

This chapter is intended to introduce the notion of the syllable and the fundamental theoretical framework along with Optimality Theory (OT), which pertains to the description and the analysis of the current study. Before delving into the theoretical background, it should be emphasised that there is an established consensus about the significance of the syllable in phonology among phonologists, such as Vennemann (1972), Hooper (1972, 1976), and Kahn (1976). Be that as it may, the role of the syllable in phonological theory is controversial. Historically, some scholars disregarded the concept of the syllable and believed that phonological generalisations can be interpreted in terms of linear strings of segments rather than referring to the syllable as a linguistic unit. On the other hand, many phonologists have advocated the notion of the syllable, realising the role of syllable in the phonotactic structure of many languages.

The fact is that the syllable has gained wide acceptance among many scholars as a primary phonological entity. Thus, various representations of syllabic weight have been introduced to literature. The most prevalent representations of syllabic weight are skeletal slot theories, including CV and X-slot models (McCarthy 1979, Clements and Keyser 1983, Levin 1985), and Moraic Theory (Hyman 1985, Hayes 1989). Adopting the moraic model would lead to certain theories and conditions. One of these theories is the Prosodic Theory, which has certain rules based on minimal lexical word requirements. These requirements should be respected regarding the mora and feet levels.

To maintain the notion of word minimality restrictions in Northern Najdi Arabic (NNA), two varying views are captured to distinguish between final and non-final CVC syllables in terms of syllable weight. Also, the last segment of superheavy syllables CVVG, CVVC, and CVCC is treated differently in order to avoid trimoraic syllables. Consequently, two analytical proposals will be provided: extrasyllabicity and more sharing principle. With reference to stress assignment and foot construction, Metrical Stress Theory provides an adequate description for stress parameters and foot construction cross-linguistically including NNA. In accounting for phonological aspects in NNA, Optimality Theory (OT) is adopted as the framework in order to provide a formal analysis of a wide variety of phonological phenomena under consideration.

The organisation of this chapter is as follows. Section 2.2 provides an overview of the syllable and its roles in the overall theory of grammar. Sections 2.3 and 2.4 briefly introduce general notions of the generative phonology theories; namely, CV and X-slot models. Thereafter, Moraic Theory is discussed in more detail along with its primary tenets and parameters in section 2.5, since the analysis and description are couched within the framework of moraic phonology when relevant throughout the thesis. Next, section 2.6 highlights the word minimality condition within prosodic hierarchy in a language. This is followed by two subsections, 2.6.1 and 2.6.2, which concentrate on how the last consonantal segment is treated differently in CVC, CVVC, CVVG and CVCC syllable structures concerning the syllable weight. Section 2.7 sheds light on Metrical Stress Theory and its principles as the dominant framework for analysing stress assignment patterns and foot construction in the current work. Section 2.8 summarises the main concepts and tenets of Optimality Theory, which is utilised as the basis framework in the analysis of different phonological processes in the grammar of NNA throughout the thesis. Lastly, a summary of the whole chapter is presented in section 2.9.

2.2 The Syllable in Phonological Theory

Historically, ‘the role of the syllable in phonological theory has been controversial’ (Kenstowicz 1994: 250). Bloomfield (1933, 1935), Bloch and Trager (1941), Kohler (1966) and Chomsky and Halle (1968) did not draw considerable attention to the notion of the syllable in their work. Instead, they employed the feature ‘syllabic’ in order to differentiate between consonants and vowels and other phonological generalisations. More specifically, the model outlined in Chomsky and Halle’s (1968) seminal work *The Sound Pattern of English* (SPE) neglected the concept of the syllable. The SPE model was the traditional framework in generative phonology. Under this model, phonological phenomena are represented as a linear sequence of segments plus boundaries [+/- word boundary], in order to make up a rule for a specific phonological process in a language. Thus, the syllable has no locus in the SPE approach and even at the early stages of generative phonology (see Chomsky and Halle (1968) for details).

Examples of the linear rule model can be seen in Davenport and Hannahs (2010: 148-149) showing the treatment of the common process of word-final devoicing, as in German and Yorkshire English. This phonological phenomenon indicates that stops become voiceless in word-final position. This rule can be given in a straightforward linear characterisation, as shown in (2.1) below:

(2.1) Word-final Devoicing Rule

$$\begin{pmatrix} -\text{continuant} \\ -\text{sonorant} \end{pmatrix} \rightarrow [-\text{voice}] \; / \; \_\#$$

While the linear fashion approach can express some phonological generalisations, there are other common phonological processes that cannot be insightfully addressed by adopting only linear order of segments and specifications. Thus, these phonological processes are better analysed with reference to the syllable. For instance, the English clear and dark /l/ can be distinguished and analysed explicitly in terms of syllable and syllable structure. In a general sense, it could be assumed that /l/ surfaces as [l], and it is associated with the syllable onset, such as *light* [laɪt], however /l/ surfaces as [ɫ], and it is associated with the syllable coda, such as *heal* [hi:ɫ] (Turton 2016).

Anderson (1969: 141) posed a question for those who disregarded the notion of syllable in generative grammar: "are there in general phonological rules which can be stated more appropriately in terms of the syllable than in terms of simply of the segment?" Many phonologists answered this question insisting that the syllable is an essential unit to produce rules in phonological generalisations. For instance, Hooper (1972) stated that stress assignments require syllable boundaries to be captured, such as antepenultimate stress in the word *algebra* ['æl.dʒə.brə][4]. Also, Hoard (1971), Venneman (1972) and Hooper (1976) presented rules that suggest inserting syllable boundaries to express phonological representations in many languages. For instance, Broselow (1979) proposed that pharyngealisation in Cairene Arabic is best investigated with reference to the syllable in order to account for pharyngealisation alternations. Pharyngealisation spreads to all tautosyllabic members, and its span is thus the syllable.

Generally speaking, the SPE fails to purely capture some phonological aspects of human languages without reference to the syllable. Soon after its proposal was abandoned in the 1970s, the concept of the syllable has since gained ground and has been deemed an indispensable unit for expressing various phonological phenomena in subsequent works. To clarify, additional evidence for the syllable as a phonological entity is the presence of phonological rules that employ at syllable edges. Cross-linguistically, syllable edges correlate with word/utterance

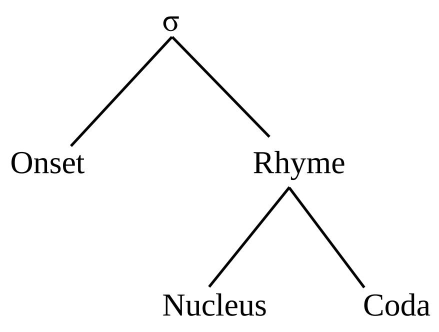
[4] Dots delineate syllable boundaries/breaks hereafter.

edges. Without reference to the syllable, such rules should be set out in order to capture the rule of syllable edges, such as ____ {#, C} or / {#, C} ____ . These rules are problematic due to boundary symbols and consonants not constituting a natural class. Consequently, such rules are best elucidated by introducing two environments: syllable-initial and syllable-final. For example, the rule of aspiration in English states that syllable-initial obstruents are aspirated, whilst in Sierra Popoluca, syllable-final obstruents are aspirated (Blevins 1995: 209).

With each passing decade, phonologists from a wide range of theoretical perspectives agree that the role of the syllable in phonological theory has become more important. Kahn (1976) was the first American scholar who investigated the notion of the syllable within the framework of generative phonology. He assumed that particular phonological generalisations in some languages can be addressed sufficiently when segments are organised into syllables. In his dissertation, he provided and advocated for two compelling arguments in favour of the syllable. First, native speaker intuitions about the syllable. Second, the feasibility of the syllable in expressing a vast range of phonological processes in generative grammar. For example, all English native speakers can implicitly judge which initial clusters are permissible in their language and which ones are not. In a similar vein, the sequence of initial syllable clusters such as /tr/ and /str/ are possible clusters, whilst the strings of initial clusters /tl/ and /nt/ are not possible in English. Assuming that every word should be parsed into syllables, and that /tr/ is a well-formed syllable onset; however, /tl/ is not. To be more precise, without reference to syllable, sometimes it is difficult to explain such phenomena to non-native speakers of a certain language. For example, English speakers intuit that the first syllable of *Atlantic* is [at], but the first syllable of *atrocious* is just [a]. As mentioned earlier, English permits word-initial cluster [tr] but not [tl]. Assuming that all words are parsed into syllables, and syllable rules are the same regardless of word position. It can be surmised that [tl] is a disfavoured syllable onset, and that [tr] is acceptable. We conclude that [at.lan.tic] is an acceptable syllabification pattern of the word *Atlantic*, while [a.**tl**an.tic] is disfavoured syllabification due to the ban of the word-initial cluster [tl]. Also, the syllabification of [a.**tr**o.cious] is acceptable due to the permissible word-initial cluster [tr], whilst [at.ro.cious] is unpreferred syllabification. All in all, such intuitions motivate the existence of the syllable as a plausible phonological constituent in a language. It is obvious, therefore, that the syllable is an indispensable unit of phonological description that simplifies such rules by invoking natural classifications, like syllable initial and syllable final (Kenstowicz 1994: 250-252).

Vennemann (1972), Hooper (1972), and Kahn (1976) asserted that the syllable is a significant entity in phonological representations and should be represented with boundaries. Kahn (1976) proposed an independent autosegmental tier of a syllable as a new level of phonological representation instead of rules that link segments to a flat syllable structure. Hence, Kahn's theory was the first to adopt autosegmental phonology in a theory of syllable structure (Cairns and Raimy 2011). Clements and Keyser (1983) provided a minimal expansion of Kahn's proposal and covered more phonological processes, like complex segments and compensatory lengthening with reference to the syllable. They differed principally from Kahn in that they considered the syllable a constituent that has a tripartite organisation consisting of an onset, a peak or a nucleus, and a coda. Ultimately, all these constituents are dominated by the syllable node. Fudge (1969, 1987) was the first phonologist who formalised a fully developed theory of the syllable as an organised unit within a generative framework. Fudge stated that the syllable has two tasks: to act as the place for extraordinary prosodic features and to represent phonotactic constraints. He identified constituents within the syllable according to particular labelled nodes. These constituents authorise a certain class of phonemes to dwell in nodes. Cairns and Mark (1982) agreed with Fudge (1969) on categorising the syllable into two parts: the onset and the rhyme, in which the rhyme is split up into two subdivisions: the nucleus and the coda. There are various representations of the internal structure of the syllable. The most common representation is sketched in (2.2) below:

(2.2) Internal Syllable Hierarchy



As can be readily seen in (2.2), the lower case sigma (σ) is designated for the syllable. The syllable (σ) dominates both the onset and the rhyme. The onset is the first constituent of the syllable structure and should be filled by a consonant or a consonant cluster depending on a language restriction. The rhyme dominates both the nucleus (also known as a syllable peak) and the coda. The nucleus can be generally filled by a vocalic segment, i.e., short, or long vowels. However, in some conditions, the nucleus may be filled by syllabic consonants,[5] as in some English accents. The coda is the final constituent of the syllable and can be filled by a consonant or a consonant cluster depending on the language restriction. Thus, onsets and codas are optional constituents because they are subject to language-specific restrictions. However, cross-linguistically, the minimal syllable requirement is a vowel. This requirement denotes that the nucleus is mandatory, and it is treated as the head of the syllable. Note also that no syllable can be obtained without a nucleus. This is supported by Angoujard (1990) in which the theory of the syllable has certain principles and parameters, as outlined in (2.3):

(2.3) Syllable Parameters and Principles (Cited from 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’.

As stated in (2.3), the first principle ensures that the syllable must contain a peak (nucleus) which is obligatory in the syllable. The second principle postulates a maximal limit for the number of segmental positions which is subject to language constraints. Finally, the order of segments is controlled by the sonority hierarchic relationship which represents the sonority values for each segment, as we shall see and dwell more in Chapter Three.

With acknowledgment of the syllable, a number of works were carried out (Selkirk 1980, Kiparsky 1981, McCarthy 1982). The syllable was the main ingredient to utilise a non-linear model in order to manifest certain phonological generalisations. For instance, in his PhD dissertation, McCarthy (1979, published later in 1982), proposed skeletal tiers involving a non-linear model to analyse a wide range of phonological processes in Arabic and Hebrew. Selkirk (1980) relied on prosodic categories such as syllable, stress foot, and prosodic word, which play a vital role in determining the English word stress. In Kiparsky’s (1981) study, he supported the notion of the syllable as a prosodic level in the phonological representation, assuming that its structure can be represented as a metrical structure. Overall, the role of the syllable has

[5] In English, /m/, /n/, and /l/ can form a syllable on its own; for example, the word /bʌtən/ renders [bʌtn̩] (Ladefoged and Johnson 2015). Likewise, In Czech, the sonorants /r/ and /l/ and seldom /m/ and /n/ are syllabic in certain cases. For instance, the liquid /l/ as in /vlk/ ‘*wolf*’ becomes syllabic [vl̩k], /krk/ ‘*neck*’ becomes [kr̩k], and /osm/ ‘eight’ becomes [osm̩] (cf. Kenstowicz 1994: 255).

remained substantially important in most phonological theories. In particular, with the advent of Optimality Theory, the role of the syllable has become more pivotal in phonological theory.

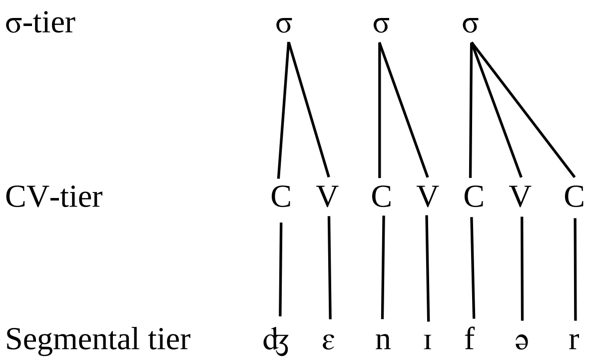
The syllable has different weights: light, heavy and superheavy, depending on specific parameters and rules. These rules and restrictions are often language-specific rather than universal. In many languages, the domain of syllable weight or syllable quantity plays a role in prosodic aspects, which is not only restricted to stress systems. However, other phonological processes are potentially sensitive to syllable weight, including compensatory lengthening, tone assignment, vowel epenthesis, and permissible syllable structures in a language. Consequently, phonologists have formalised and developed three different theories representing either segmental duration or syllable weight. These theories have been broadly accepted to some extent: two skeletal slot models, involving CV and X-slot models and recently Moraic Theory (Gordon 2006: 1-2). Clements and Keyser (1983) presented a third tier known as CV-tier, which intervenes between two skeletal tiers; namely, the syllable tier and the segmental tier. The notion of the syllable has continued to be an essential tool in explaining syllabic weight, which triggers a wide range of phonological phenomena. The most outstanding studies are those of Halle and Vergnaud (1980) and Levin (1985) in which they replaced the CV-tier with X-slots. A couple of years later, Hayes (1989) brought to phonological theory a new notion called mora, which replaced the CV-tier and the X-slots regarding syllabic weight in subsequent works. These distinctions are discussed further in following sections. In brief, the concept of the syllable has been shown to have a well-defined condition in phonological theories. Thus, phonological processes are best explained by referring to the syllable in order to obviate certain problematic analysis that emerged within the old linear fashion approach in generative phonology.

There are ample justifications to develop a theoretical contribution of the syllable regarding syllabic quantity. The subsequent sections (2.3, 2.4, and 2.5) outline the evolution of syllabic weight analysis by means of various representations of syllable theories. There have been two competing segmental theories in the literature; namely, CV Theory and X-slot Theory. However, Moraic Theory will be adopted in the current study.

2.3 CV Theory

Under this theory, each segment must be dominated by either a C or a V node (Levi 2011: 344-345). Hence, this specification assists in differentiating between vowels and glides, and therefore replaces the former feature [±syllabic]. McCarthy (1979, 1981), Halle and Vergnaud (1980), Steriade (1982), and Clements and Keyser (1983) classified syllable representations into three-tiered structures receiving the fundamental features of an autosegmental system. The first tier represents the syllable or σ-tier, which constitutes the single element σ. The second tier represents the CV-tier, which constitutes the two elements C and V. The third tier represents the segmental tier or (nucleus tier), which constitutes the linear representation of phonetic matrices presenting consonants and vowels with its own plane or level of representation. The σ-tier indicates the number of syllables a word contains. For example, the Arabic word /jað.hab/ 'he goes' is composed of two syllable peaks. This implies that each syllable must contain a vowel. The CV-tier identifies the feature [syllabic] in which a segment linked to the C node of the CV-tier is non-syllabic, whilst a segment linked to the V node of the same tier is syllabic. Likewise, the CV-tier locates functional positions within the syllable. For instance, a diphthong functions as two vowel qualities filling the position of a single vowel and occupying only one syllable. Moreover, a geminate consonant is manifested as a single segment spreading over two C positions. The segmental tier is responsible for generating well-formed sequences on each tier. The three-dimensional model is taken from the work carried out by Clements and Keyser (1983), as shown in (2.4) below:

(2.4) A three-tiered Representation of the Syllable



The representation above shows that any segment in the CV-tier, either a consonant or a vowel, is viewed as the immediate constituent of the σ node and nothing else. Likewise, any segment in the segmental tier is deemed to be the immediate constituent of the CV-tier. In the CV-tier, any segment dominated by V is defined as a syllable peak, whilst any segment dominated by C is defined as a syllable non-peak or a syllable margin. Moreover, the CV-tier can designate the units of timing; for instance, long segments fit in with two units, whereas single segments fit in with one unit, as shown in the following representations (2.5):

(2.5) Vowel Representations Under CV Theory (Clements and Keyser 1983: 25)

Cross-linguistically, Hyman (1985: 13) stated that the CV tier is borne out by a threefold primary operation. First, it supplies the value of syllabicity in which a consonant values [-syll] and a vowel [+syll]. Second, it supplies a measure of the number of units in each segmental matrix it is associated with. Finally, it operates as a core for the various segmental and autosegmentalised traits to connect to.

The CV model has been widely criticised; for example, it does not account for a predictable CV tier redundancy[6]. In this view, Steriade (1984) proposed X as a suitable element for the CV tier to capture the predictability of glide/vowel alternations in Latin (Levi 2011: 344-345). The next section will throw light on X-slot theory as an alternative representation of the syllabic skeleton.

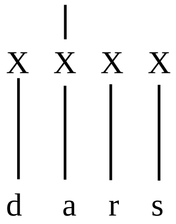
2.4 X-slot Theory

X-slot Theory was developed by scholars including Kaye and Lowenstamm (1984), Steriade (1984), and Levin (1985), replacing the syllabic skeleton from CV theory to X-slot theory. In the X-slot model, the skeleton is formed from a string of empty slots defined as simple points or Xs in lieu of CV-slots, as found in the previous theory (recall the explanation in section 2.3). These empty positions or slots may link to either a consonant or a vowel, which take place from left to right.

X-slot is depicted in the following representation (2.6), utilising an Arabic word [dars] ‘lesson’ as an example:

[6] X-slot theory grants vowels and glides to shift freely between peak and non-peak constituents in the syllable without carrying out rules that alter skeletal slots, e.g., C→V. Consequently, Levin (1985) utilised X instead of CV for all skeletal positions (cf. Itô 1989).

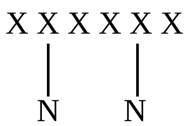
(2.6) Skeletal Tier Representation of X-slot Model



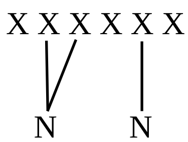
All segments are replaced with X-slots, respectively. As a consequence, /d/ links with the leftmost skeletal position, /a/ links with the second skeletal position, and so forth. The evidence that evokes the replacement of the CV skeleton by the X-slot skeleton is supported by the fact that a skeletal position may connect with either a consonant or a vowel. However, this interpretation might be difficult to espouse if the feature -/+ consonantal represents the skeleton; for instance, in the case of the definite prefix in Tiberian Hebrew. The definite prefix geminates a following non-guttural consonant, as in [ham-**m**elek] 'the king'. Also, this can be achieved when the following consonant is guttural; however, the vowel of the definite prefix is lengthened, such as in [haa-**ʕ**iir] 'the city'. Given that, if the definite prefix contains an empty X-slot, then it is free to associate with any segment, which in turn, is inapplicable in the CV skeleton. Another example highlights the distinction between consonantal and vocalic slots. In the Arabic CVCCVC and CVVCVC syllable structures, the difference between consonantal and vocalic slots is fateful. These examples clarify that the vocalic slots associate with a preassigned nucleus, whilst the consonantal slots are associated with nonnuclear slots (Watson 2002: 52). A modification of Levin's proposal (1985) is formalised to show the difference between the Arabic CVCCVC and CVVCVC sequences under X-slot Theory, as shown in (2.7):

(2.7) The Syllable Patterns of CVCCVC and CVVCVC in Arabic

(a) CVCCVC



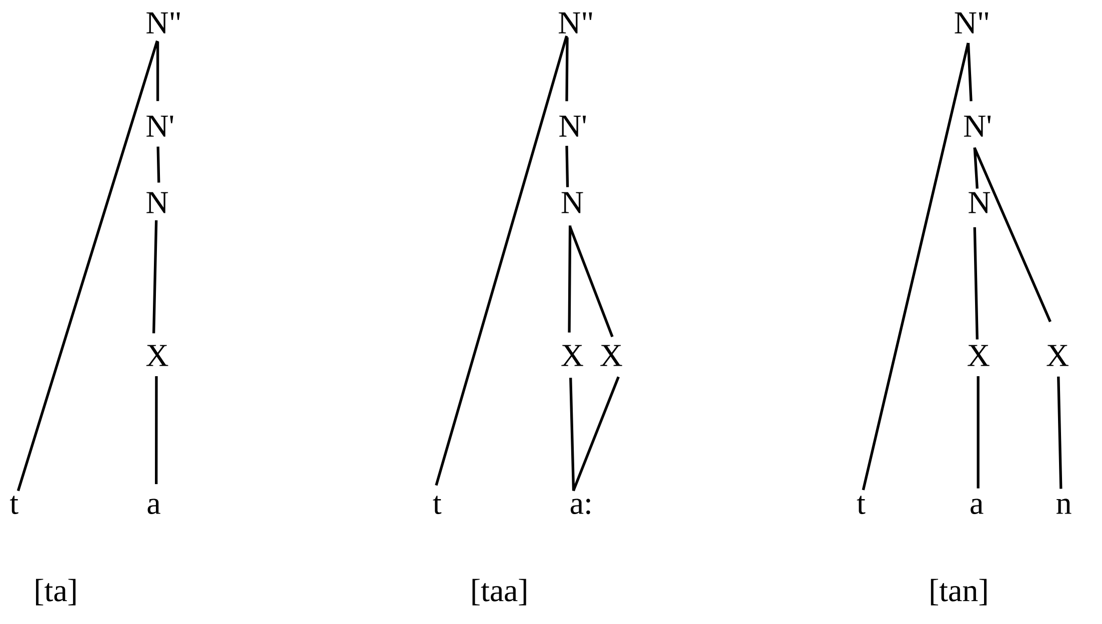
(b) CVVCVC



Under X-slot theory, each X-slot indicates a single time unit. Phonological weight is determined by the number of skeletal positions in the rhyme of a syllable. It should be noted that long vowels or consonants can be elegantly differentiated from short ones by association with two consecutive skeletal positions at specific levels of projection in a syllable. Long vowels and closed syllables count as heavy syllables, which are associated with two skeletal positions in a syllable. Short open syllables count as light and are associated with one skeletal position in a syllable. It should be borne in mind, however, that the distinction between light and heavy syllables is subject to language-specific restrictions. To elaborate, languages such as Lardil treat only long-vowelled syllables as heavy, whilst the group of closed syllables and short-vowelled open syllables are treated as light. Additionally, even though languages like Aklan lack long vowels, they can draw a distinction between open and closed syllables as light versus heavy (Kenstowicz 1994: 428). By and large, initial consonants in onset position are deemed weightless. The following representations in (2.8) are based on Kenstowicz (1994: 427) showing the phonological weight under X-slot model:

(2.8) X-slot Theory Representations

(a) light syllable CV **(b)** heavy syllable CVV **(c)** heavy syllable CVC



As can be seen in the three diagrams above, the segments in onset position are weightless and associated directly to the N'' node. Each segment is attached to a timing slot in which short segments are associated with one timing slot and long segments are associated with two timing slots in the skeletal tier. The syllable peak or head is defined with the nucleus node (N). A higher syllable projection N' node dominates any post-nuclear elements, and an N'' syllable projection that dominates N' is also in charge of dominating pre-nuclear elements.

To wrap up the presentation of the CV and X-slot theories, they both deal with the skeleton from the perspective of segments. Consequently, the prosodic tier presents an accurate number of prosodic elements in an utterance compared to the number of segments it entails (Kenstowicz 1994: 428). A new theory has been proposed by Hayes (1989) based on the generalisation noted by Hyman (1985), and McCarthy and Prince (1986). Hayes argued that the compensatory lengthening (CL) phenomenon is best explained by abandoning the X-slot Theory, despite the fact that the X-slot Theory is inappropriate to induce CL and the vowel deletion in onset position. That is to say, this theory 'assigns the same prosodic structure to identical sequences across languages, irrespective of the presence or absence of a syllable weight contrast. Thus, it is unable to explain why CL occurs only when there is a pre-existing syllable weight distinction' (Hayes 1989: 297-298). Eventually, a plausible account of the phonology of syllable weight was proposed by Hayes (1989), who developed the conception of Moraic Theory. This theory will be discussed comprehensively in the next section.

2.5 Moraic Theory

Researchers have shown much interest in moraic theory, on which this study is mainly based where relevant. Moraic theory was first proposed by Hyman (1985), McCarthy and Prince (1986), and later developed by Hayes (1989). This theory is a model of quantity utilising moras or morae as a basic unit of weight, conventionally symbolised as the Greek mu (μ). Thus, the moraic model replaces the older X-slot (skeletal tier) system, and moras are employed instead. The level of moras is mediated between syllable nodes and root nodes. The question now arises as to why this alternation happened. To demonstrate this point, Hayes argued against the notion of segmental X-slots theory and CV theory. He stated that these theories have an insufficient analysis to fully demonstrate which type of segmental deletion triggers compensatory lengthening in specific languages. It is in fact that the possible rules in both theories are arbitrary and stipulative; however, this behaviour can be easily interpreted as a natural consequence of the axioms of moraic theory. An example cited from (Sezer 1986) flaunting the phonological process of segmental deletion in postvocalic environment that triggers compensatory lengthening in Turkish, as shown in (2.9):

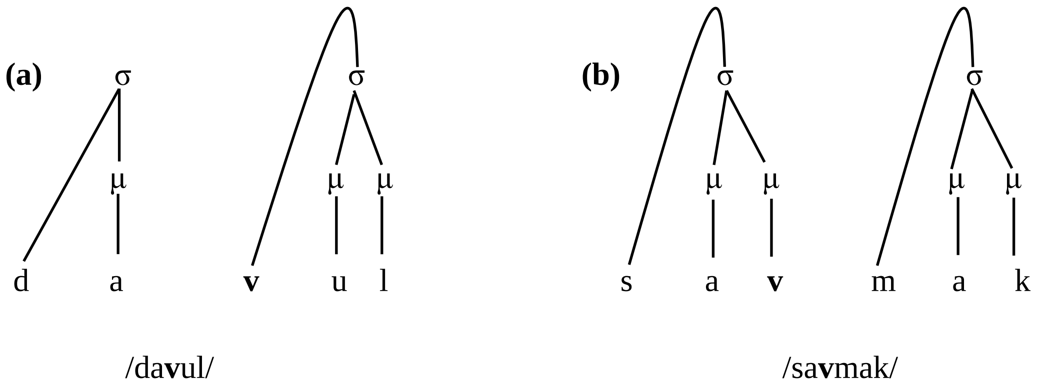
(2.9) Turkish Optional /v/ Deletion (Sezer 1986: 228)

a. /da.**v**ul/ ➡ [daul] ‘drum’

b. /sa**v**.mak/ ➡ [s**a:**mak] ‘to get rid of’

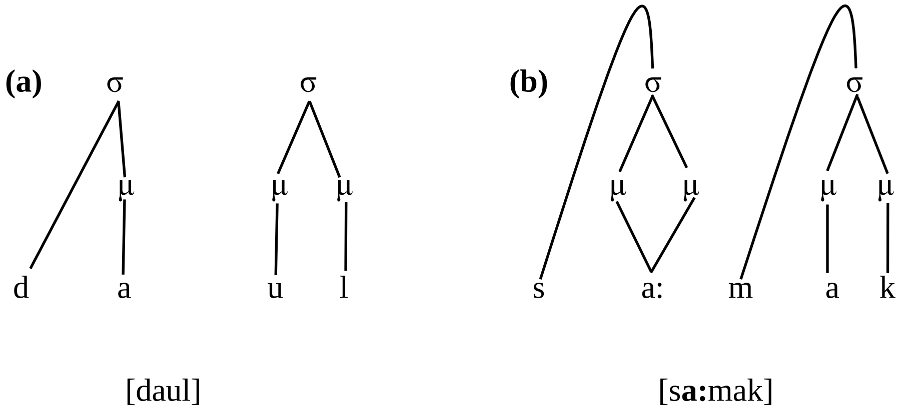
It should be noted from the examples above that in (2.9a) the deletion of the /v/ does not trigger lengthening of the preceding vowel, but the deletion in (2.9b) does. With the advent of moraic theory, a neat explanation of vowel lengthening was provided by Hayes, namely that in (2.9b), the deleted segment /v/ is a moraic segment because it resides in the coda position of the initial syllable. However, in (2.9a), the deleted consonant /v/ is a non-moraic segment because it is the onset of the second syllable. Consequently, Hayes provided a compelling argument stating that compensatory lengthening includes the forfeit of a moraic segment without the deletion of the mora (Davis 2011: 105). Consider the following syllabification and moraic structure of the Turkish words presented earlier in (2.9a & b) before compensatory lengthening process is carried out, as shown in (2.10) below, where (μ) indicates a mora:

(2.10) Mora and Syllable Structure in Turkish (Davis 2011: 106)



Now, let us see the syllabification and moraic structure of the Turkish words after compensatory lengthening is applied, as illustrated in (2.11):

(2.11) Mora and Syllable Structure of Compensatory Lengthening in Turkish



(Davis 2011: 107)

As can be inferred by examining (2.10) and (2.11), compensatory lengthening is implemented in (b) in order to retain the mora despite the deletion of the segment. Hayes (1989) observed that the rule of Weight-By-Position (WBP) is active in the Turkish language, assuming the deletion of a moraic segment leads to compensatory lengthening for the sake of preserving the underlying mora, but not with a non-moraic segment.

A mora has two main roles in this theory. First, it makes a neat distinction between light, heavy, and superheavy syllables, which are considered to be the genuine or reliable unit of prosody. Second, the mora is treated as a phonological position where a long element is introduced as being doubly linked in the prosodic tree (Hayes 1989: 254, Kenstowicz 1994: 428). Furthermore, the target of such theory is extended to other phonological generalisations. For instance, implementing mora distinctions can be accounted for stress and tone assignments cross-linguistically. AL-Jarrah (2002) asserted that utilising mora is fundamental to account for stress assignments because it is shown a clear-cut distinction between different types of syllabic weight, i.e., Arabic has three syllable weight types: light, heavy, and superheavy. All theorists agree that light syllables are assigned a single mora and are thus monomoraic. Heavy syllables are assigned two moras and are thus bimoraic. By contrast, superheavy syllables are trimoraic[7] since they contain three moras, which is relatively uncommon across languages (Hayes 1989: 291). Consider the following configurations of short, long vowels, and diphthongs[8] within moraic theory in (2.12) below:

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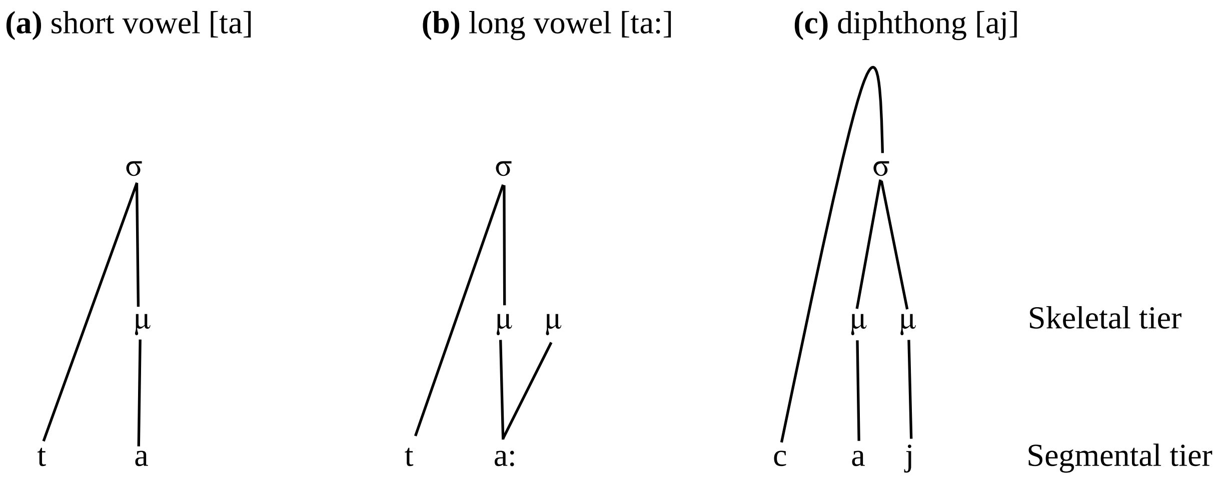
[7] Trimoraic syllables occur in languages that have a three-way vowel length distinction (/v/, /v:/, and /v::/), such as Estonian, German and Danish varieties. Under moraic theory, every vowel demands a single mora, that is, /v::/ occurs in a trimoraic syllable. Further, the occurrence of trimoraic syllables is motivated by compensatory lengthening in doubly closed syllables (Hayes 1989: 292).

[8] In Arabic, diphthongs are counted to be formed from two adjacent melodic segments (a vowel + glide): /aw/ and /aj/. For more details, (read the Arabic vowel inventory in Chapter One).

(2.12) The Weight Representation of Short Vowel, Long Vowel, and Diphthongs



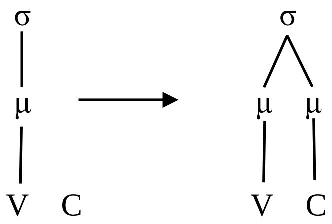
(Hayes 1989: 254, Watson 2002: 55)

The noteworthy difference can be drawn between a short vowel, a long vowel, and a diphthong (in Arabic) lies in the number of moras it contains. That is, long vowels and diphthongs are underlyingly associated with two moras, while short vowels are underlyingly associated with one mora. Likewise, onset consonants have no bearing on the weight of a syllable since they are directly linked to the syllable node (Hayes 1989). Therefore, onsets are counted as moraless or weightless in a syllable because onsets are unrelated to bundles of universal phonological processes that are crucial to syllable weight, as found in Arabic (cf. McCarthy and Prince 1986 and Davis 2011: 116). This idea of onset weight cannot be generalised cross-linguistically since some scholars prove the opposite. To clarify this, onsets may contribute weight to a syllable and count as moraic only in stress processes in a dozen languages (Davis 1985). Gordon (2005) examined thirteen languages and found that these languages have onset-sensitive stress. Furthermore, Topintzi (2006) pointed out that three languages in South America – namely, Pirahã, Arabela and Karo – have onset-sensitive stress in which stress falls on a syllable beginning with a voiceless consonant. Thus, these languages treat voiceless onset consonants as moraic; which in turn, can attract stress. In general, the moraicity of onsets is assumed to be confined to stress assignments in some languages (Davis 2011: 117). However, in the case of Arabic, onsets are moraless and are not counted in stress parameters including NNA. In this study, therefore, the nuclei and codas contribute to the weight of the syllable and operate in stress assignment rules, as will be discussed in great detail in Chapter Five.

Singleton codas are underlyingly moraless unless they are moraified by the parametric rule Weight-By-Position (WBP). The following representation in (2.13), which is adapted from Hayes (1989: 258), shows the WBP rule under Moraic Theory:

(2.13) Weight-By-Position Rule

(a) Coda in Final Position **(b)** Coda in Non-final Position

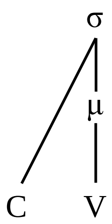


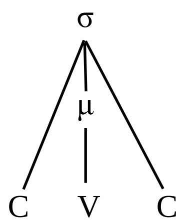
where σ dominates only μ

This parameter grants a mora to consonants that reside in coda position of non-final CVC syllables where certain languages count CVC as a prosodically heavy syllable. As a result, the WBP stipulation ensures that the weight per syllable is maximally bimoraic (Hayes 1989). Cross-linguistically, geminate consonants are underlyingly assigned a single mora, which can be differentiated from singleton consonants (cf. Davis 2011: 106). Under this account, consider the hypothetical derivations sketched in (2.14), which shows the moraic weight of light vs. heavy syllables: (G stands for a geminate consonant).

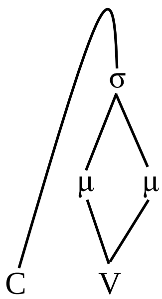
(2.14) Moraic Weight of Light and Heavy Syllables (Davis 2011: 106)

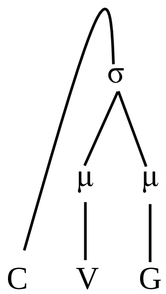
Light syllables **(a)** CV **(b)** final CVC

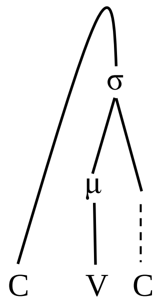




Heavy syllables **(c)** CVV **(d)** CVG **(e)** non-final CVC







The representation of syllable structures acts as a blueprint for categorising weight patterns across languages employing mora as a measure of syllable weight. Also, these delineations can manifestly distinguish between two types of syllables, i.e., light versus heavy syllables. Thus, it is obvious that onsets are moraless in all syllable structures that are directly adjoined to the syllable node. Light syllables, as represented in (2.14a) and (2.14b) are monomoraic. In the former, the vowel bears only one mora. In the latter, the CVC syllable is monomoraic when it only emerges in the coda of a word-final syllable, which hinges on the WBP rule (cf. Watson 2002: 54). On the other hand, I assume that heavy syllables, as shown in (2.14c, d, and e) are bimoraic, since they bear two moras. In (c), an underlying long vowel in the CVV sequence is mapped into two moras on the surface. In (e), the CVC heavy syllable is counted to be bimoraic if the coda occurs in a non-final syllable. Hence, it acquires a single mora introduced by the dotted line through the Weight-By-Position rule. This rule can be applied to NNA when a CVC syllable occurs in non-final syllables, but not in the case of final syllables, which counts as light because it assigns only one mora. Further, in (d) the syllable closed by a geminate is bimoraic (more discussion about the moraification of geminates will be presented later in this chapter). All phonologists agree that the weight of a CV syllable is universally light and bears one mora; whereas a CVV syllable is universally heavy and bears two moras. On the other hand, other types of syllable patterns are still somewhat cross-linguistically controversial. Overall, under moraic theory, not all segments are eligible to receive a mora; however, the only segments that are entitled to assign a mora are those under the syllable rhyme node (Hyman 1985, Hayes 1989).

The weight of a CVC syllable is undetermined because it is language specific, since not all coda consonants in a language are weight-bearing. For example, in Lithuanian, only sonorant codas are moraic (Davis 2011: 110). Thus, a CVC syllable may count as light or heavy, relying on the moraicity of coda in a particular language, which is contingent on the possibility of applying the parametric rule of WBP. For instance, languages lack the WBP rule, such as Lardil, whereby long vowels are heavy and closed syllables are light. Hence, there is apparently no reason to hold the WBP rule because all CVC syllables are treated similarly whether a coda resides in word-final or non-final syllables. Moreover, languages like Hindi, Malayalam, Levantine, and Egyptian Arabic are different when implementing the rule of WBP. According to Broselow *et al.* (1997: 63-65), the rule would be applicable in Hindi because all codas are dominated by a mora, but not in Malayalam due to all codas being moraless. In Levantine and Egyptian Arabic, codas are restricted when they are mora-bearing. More specifically, in Levantine Arabic, codas carry moras when following short vowels but weightless when following a long vowel. In

Egyptian Arabic, codas are assigned a mora when a long vowel is shortened in a closed syllable, realising lexical CVVC as CVC to avoid trimoraic syllables. According to Watson (2002: 58), a coda in an internal CVC syllable is underlyingly moraless; however, it is moraified only through the parametric rule Weight-By-Position. For instance, in domain-final syllable position, both Cairene and San'ani Arabic treat CVC syllables as prosodically light and are thus monomoraic. By contrast, in domain-internal syllable position, those languages treat CVC syllables as prosodically heavy and are thus bimoraic. Similarly, the weight of CVC syllables was examined in two modern Arabic dialects; namely, Meccan and Hadhrami Arabic (Bamakhramah 2009). He noted that both dialects consider CVC syllables as monomoraic (light) when they emerge in final syllables, whereas non-final CVC syllables are bimoraic (heavy) because the coda acquires mora through WBP.

The weight of CVVC and CVCC syllables are mostly language-specific, varying according to a language criterion of syllable weight. This difference can be achieved through different representations depending on the moraic status of codas in certain languages. To clarify, referring to the same languages mentioned above by Broselow *et al.* (1997: 70), these languages treat codas of CVVC and CVCC patterns differently. In Hindi, each coda consonant has its own mora, denoting that CVVC and CVCC syllable patterns are trimoraic. In Malayalam, by contrast, CVVC syllables are bimoraic and CVCC syllables are monomoraic since all coda consonants are weightless. Watson (2002: 58) pointed out that CVVC and CVCC syllable structures are restricted to a phonological word-final position in San'ani Arabic. Thus, CVVC and CVCC are subject to the WBP parameter. In this case, CVVC and CVCC syllables are bimoraic in San'ani Arabic. Additionally, Abu-salim and Abdel-Jawad (1988) pointed out that CVVC and CVCC syllables are bimoraic in Levantine Arabic. A syllabification algorithm of various syllable patterns can be depicted in some languages based on moraic theory, as shown below in (2.15):

(2.15) Moraic Weight of Syllable Structures in Various Languages (Watson 2002: 58, Bamakhramah 2009: 11)

(a) Moraic Weight in Hindi in All Word Positions

(b) Moraic Weight in Malayalam in All Word Positions

```
   μ       μ μ      μ        μ  μ        μ
   |       | |      |        |  |        |
 C V     C V V    C V C    C V  V C    C V C C
```

(c) Moraic Weight in Levantine Arabic in Final Syllables

```
  μ       μ μ      μ μ      μ  μ       μ μ
  |       | |      | |      |  |       | |
 C V     C V V    C V C    C V  V C   C V C  C
```

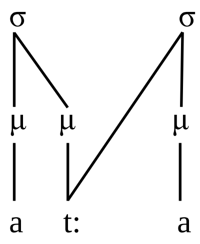
(d) Moraic Weight in San’ani Arabic in Final Syllables

```
  μ      μ μ       μ        μ  μ       μ μ
  |      | |       |        |  |       | |
 C V   C V V    C  V C    C V  V C   C V C C
```

It can be inferred from all the representations above that the syllable weight is language-specific. For example, trimoraic syllables are prohibited in some languages as in San’ani Arabic and Malayalam because they limit the weight of a syllable to being bimoraic. However, in other languages, trimoraic syllables are tolerated in certain positions in a word and/or a phrase as in Hindi. Also, the WBP rule is active in some languages, as found in San’ani Arabic (Watson 2002), Meccan Arabic and Hadhrami Arabic (Bamakhramah 2009), but inactive in other languages, as found in Malayalam and Lardil (Broselow *et al.* 1997).

With respect to geminate consonants, this theory differentiates between a geminate and a singleton consonant in a CVC versus CVG. A geminate consonant is almost always moraic, whereas a singleton consonant is underlyingly moraless, acquiring a mora through the WBP rule in the surface representation. For instance, a CVG syllable in a non-final position, as presented in (2.14d), is bimoraic since the short vocalic segment assigns one mora and the geminate consonant assigns one mora to the syllable weight. The following representation in (2.16) demonstrates a prevalent example [at:a] on how a geminate is treated under moraic theory based on Hayes’ view:

(2.16) A Geminate Representation



(Hayes 1989: 259)

[at:a]

As depicted in (2.16), the geminate (a long consonant) /t:/ carries one mora. Thus, the geminate consonant is monomoraic because the first part of the geminate resides in the coda position of the first syllable. However, the second part of the geminate consonant serves as the onset of the following syllable, which contributes no weight to the syllable. Many Arabic dialects implement the WBP rule in which geminates are distinguished underlyingly by their moras and structurally by having their 'consonant melody 'flopped' onto a vowel-initial syllable' (Hayes 1989: 258). Thus, geminates are considered to be ambisyllabic[9]. Many languages prohibit trimoraic syllables and as a result, a long vowel cannot be followed by a geminate. This analysis is supported by the fact that a long vowel should be shortened in a syllable closed by a geminate, whereas it cannot be shortened in a syllable closed by a single consonant (Hayes 1995: 276). Vowel shortening can be applied in a potential CVVG syllable in order to avoid trimoraic syllables, whilst vowel shortening cannot be applied in a CVVC syllable because the coda in a final position is weightless. Consequently, it adheres to the maximum weight per syllable (bimoriac) in a language that bans trimoraic syllables (Davis 2011: 120). This case can be shown in the Swedish language, where vowel shortening appears before a geminate but is impossible before a singleton coda consonant (Kiparsky 2008). This provides evidence that geminates in Swedish are underlyingly moraic, though single coda consonants are non-moraic at most. Moreover, some languages allow superheavy syllables in final and/or non-final word positions. Thus, the moraic weight for these syllables are trimoraic. However, these languages prohibit trimoraic syllables and resorts to certain phonological princiles to satisfy the bimoraicity status, such as extrasyllabicity and mora sharing. The former renders the peripheral segment moraless and links it to the syllable node. The latter allows a peripheral segment to

[9] Ambisyllabic is a descriptive term to refer to a long consonant that shares two contiguous syllables, resulting the coda of the first syllable and the onset of the following syllable.

share a mora with the preceding vowel (restricted to CVVC syllables) (Hayes 1982, 1989, 1995, Kiparsky 2003, Watson 2007) (see 2.6.1 and 2.6.2 for more detail).

To recapitulate, in some languages, the position of a CVC syllable in a word can determine the weight of a syllable by applying the WBP parameter. This parameter is responsible for the moraicity of internal CVC codas in certain languages when the WBP rule is active. Thus, a CVC syllable counts as heavy when it occurs in a word-internal syllable and thus the coda is underlyingly moraic; however, a CVC syllable counts as light when it occurs in a word final position, and thus the coda is underlyingly moraless or weightless. When it comes to the weight of CVVC and CVCC syllables, some languages ban trimoraic syllables and require superheavy syllables to act maximally as bimoraic. To some extent, the avoidance of potential trimoraic syllables is a common phenomenon across languages. In this case, codas in final and non-final CVVC and CVCC syllables are analysed differently based on various perspectives and constraints to avoid trimoraic syllables. For example, in some Arabic dialects, a consonantal segment at the periphery of words in coda position is analysed differently and referred to as an extrasyllabic, extrametrical segment, or mora sharing. Also, some of these processes can be applied to a syllable closed by a single consonant in a final CVC syllable. Further details about the analysis and treatment of closed syllables CVC, CVVC and CVCC will be discussed in the next subsections. Overall, in this study, various syllable patterns, including geminates, will be analysed by adopting the moraic model to account for diverse phonological processes in NNA. Ultimately, according to Rakhieh (2009: 64), moraic theory has five advantages over other syllable theories. These advantages are outlined in (2.17) as follows:

(2.17) Advantages of the Moraic Model in the Syllable Theory (Rakhieh 2009: 64)

a. Moras are better incorporated into the prosodic hierarchy (the prosodic hierarchy will be presented in 2.19).
b. It counts onset as a weightless constituent and links it directly to the syllable node.
c. It shows various representations of coda-weight.
d. It provides an interpretation of short vs long vowels and singletons vs geminates.
e. It distinguishes between three types of syllable structure, i.e., light, heavy, and superheavy syllables.

2.6 Prosodic Theory

Building on works from prosodic phonology carried out by Selkrik (1980), Nespor and Vogel (1986) and others, McCarthy and Prince (1986, 1988, 1990a, 1990b, 1994) developed a hierarchical prosodic metrical structure in order to express the minimal word (content word) requirements. The prosodic hierarchy is composed of the prosodic word (abbreviated as PrWd), which constitutes the metrical feet, which in turn constitutes the syllables, which in turn constitute moras, respectively. That is to say, the prosodic word occupies the highest level, whereas the mora occupies the lowest level of the prosodic hierarchy. The prosodic hierarchy requires that each higher constituent consists of at least one constituent from the element immediately below. Hence, 'the minimal phonological word comprises a foot, the minimal foot comprises a syllable, and the minimal syllable comprises a mora' (Watson 2002: 129). This relation between these constituents can be supported by the Strict Layering Hypothesis (SLH) proposed by Selkirk (1984), Nespor and Vogel (1986), and Itô (1986). The hypothesis postulates that every non-highest prosodic constituent (segment, mora, syllable, word, and phrase) must be dominated by the next highest element on the prosodic hierarchy, i.e., a segment must be affiliated with a mora and a mora must be affiliated with a syllable. The representation of prosodic hierarchy assumed in this study is shown in (2.18) below:

(2.18) Prosodic Hierarchy (Selkrik 1980)

PrWd	Prosodic word/Phonological word level
|	
Ft	Foot level
|	
σ	Syllable level
|	
μ	Mora level

The prosodic hierarchy is read from top to bottom. The prosodic word predominantly encompasses a string of feet, and the minimal word is composed of at least one foot. Accordingly, the head of the prosodic word is the foot. Each content word must minimally constitute a foot, and in turn, a legitimate foot must be maximally disyllabic and minimally bimoraic (McCarthy and Prince 1986). With regard to moraic content, the minimal word is composed of either a single bimoraic syllable or two monomoraic syllables. That is to say, in quantity-sensitive languages[10] like English and Arabic, the minimal word is predicted to be maximally bimoraic. On the other hand, in quantity-insensitive languages such as French[11], all syllables are predicted to be presumably monomoraic and the minimal word is disyllabic (McCarthy and Prince 1994: 322). In Arabic, the concept of word minimality requires a word to contain minimally one foot and two moras. These two moras can be seen either in a single heavy syllable or distributed between two light syllables. Thus, the foot is maximally disyllabic and minimally bimoraic. This indicates that monomoraic words cannot be integrated into the metrical structure and in turn cannot stand alone as phonological words (Kenstowicz 1994: 642-643).

The syllable is an underlying unit of a metrical structure that consists of at least one mora, and it is arranged into constituents that make up feet. The mora is a unit of measuring syllable weight, which is larger than a single segment but typically smaller than a syllable (Hayes 1989). Consider the following representations (2.19) of the minimal word stem requirements in NNA:

(2.19) Word Minimality in NNA

(a) [ʤa:r] 'neighbour' **(b)** [gha.wa] 'coffee'

As shown in (2.19), the two prosodic words (a) and (b) satisfy the minimal word requirements. To clarify, the prosodic word in (a) [ʤa:r] 'neighbour' has a single foot that consists of one heavy syllable. The foot is composed of two moras /a:/, which conforms to the word-minimal

[10] Quantity-sensitive languages distinguish syllable weight of the rhyme as either light or heavy. For example, some languages assign stress based on the syllable weight and position.

[11] Unlike English and Arabic, French does not set a minimum lexical word constraint and does not concern stress assignment or syllable weight. Therefore, French content words may contain a single light syllable such as the words eau [o] 'water' and Feu [fø] 'fire' (Rogers 2013: 280-281, Carr and Montreuil 2013: 188).

constraints. The phonological word in (b) [gha.wa] ‘coffee’ has one foot that contains two light syllables /gha/ and /wa/. The foot is comprised of two moras assigned by the vocalic segments. It should be noted that unfooted syllables are always single light syllables (monomoraic syllables), especially at edges. Hence, the degenerate feet are immediately dominated by the prosodic word (PrWd) rather than by the foot (F) because they do not achieve the minimal word requirements. Moreover, Hayes (1995) categorised feet into two values depending on language-specific parameters: bounded and unbounded. The former feet can have no more than two syllables and the stress distribution is restricted, where stresses tend to appear in roughly equal distances. The latter feet can have an unlimited number of syllables and the stress distribution is unrestricted. Overall, the central notion of word minimality in prosodic theory depends largely on a language constraint and parameter. For example, in Mohawk, every lexical word must have at least two syllables. Conversely, some other languages require that every word must contain minimally two moras in which it must have at least one heavy syllable or two light syllables, as in Fijian and Arabic (Hayes 1995: 47). Prosodic theory will be considered in the NNA stress system and foot construction throughout this thesis.

Having presented an overview of prosodic theory and minimal word requirements, the next subsections (2.6.1 and 2.6.2) will shed light on how the last consonant of CVC, CVVC, CVVC, CVVG is tackled in the domain word-final position in order to avoid trimoraic syllables with superheavy syllables. This behaviour can be analysed differently in terms of extrametricality and extrasyllabicity in the metrical phonology. Moreover, I will demonstrate the treatment of the peripheral consonant in the coda position in non-final CVVC, CVCC, and CVVG syllables. This behaviour can be ascribed to two possible notions in the literature, semisyllables or mora sharing, in order to prevent trimoraic syllables.

2.6.1 Extrametricality and Extrasyllabicity

The concept of extrametricality (also known as extraprosodicity) was first invoked in the metrical theory of stress by Liberman and Prince (1977) and later developed in subsequent works of Prince (1983), Itô (1986), Hayes (1979, 1982, 1995), among many others. Extrametricality is defined as a device that renders a peripheral element in a phonological form invisible to stress computation or other phonological processes in a number of languages. An extrametrical segment is excluded from the calculations of syllable weight, which is conventionally enclosed in angle brackets ⟨ ⟩. Hayes (1982) proposed a unified format to identify the notion of extrametricality on universal grounds, as shown in (2.20) below:

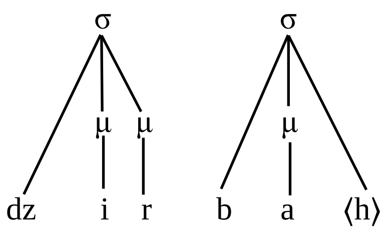
(2.20) Extrametricality Rule

X⟶ [+ extrametrical] /____]D

X represents a single phonological constituent like rhyme, consonant, or suffix, and [……]D 'is the domain in which the stress rules of the language apply (usually phonological word or phrase)' (Hayes 1982: 228). He also asserted that the advantages of the extrametrical rule are unquestionable, which can provide insights into stress systems, especially those of uninterpreted phenomena. According to Hayes (1995: 57), the conception of extrametricality is restricted to specific cases in order to be controlled. First, constituency in which extrametricality can only be the consonant, syllable, foot, phonological word, and affix. Hayes eliminated the mora from the constituency rule due to the absence of rational cases. Hence, 'there is segmental extrametricality, which exempts segments from mora assignment, and higher level extrametricality, which exempts syllables and feet from rules creating metrical structure' (Hayes 1995: 58). For instance, a syllable can be treated as extrametrical in Macedonian when stress falls on the antepenultimate syllable, which renders the final syllables as extrametrical. Second, peripherality in which an extrametrical constituent can be seen either in the left or right edge of its domain. This rule can justify why extrametricality applies to a CVC syllable in a word-final position and thus it is light (monomoraic) and not heavy (bimoraic). That is to say, the last consonant of a CVC syllable is deemed as extrametrical because it fails to assign a mora through the WBP rule and meets the peripherality condition, which limits the occurrence of extrametricality to the edges of constituents. For example, the disyllabic word in NNA [mas.raħ] 'theatre' is composed of CVC.CVC sequences in which the initial syllable counts as heavy but the final syllable counts as light because the last consonant of the rightmost syllable is subject to extrametricality status. Third, edge markedness in which the unmarked edge for extrametricality must always be single and designated only at the right edge of stress domains. This condition is motivated by a very strong tendency toward right edge extrametricality in the documented examples (Hayes 1995: 58). Nevertheless, some languages apply a similar requirement on the left edge of the word to deprive stressing the initial syllable (AL-Jarrah 2002). Finally, nonexhaustivity in which an extrametricality rule is blocked if it would make the whole domain of the stress rule extrametrical. Foot extrametricality undergoes the nonexhaustivity condition, which assures that foot extrametricality cannot be apparently applied in the case that peripheral foot is the only foot in the word. For example, the NNA word [ˈʤi.daʕ] 'throw' is composed of a bimoraic foot in which it is constructed over two light syllables and the final consonant is regarded as extrametrical. The peripheral foot constitutes the only foot in the word, thus foot extrametricality cannot be deemed as extrametrical, and the main stress is assigned to the head of the foot, the leftmost syllable.

Hayes (1982: 228) stated that employing extrametrical rules can provide a clear vision in yielding insights about the English stress assignment, in the treatment of word-final syllables in quantity-sensitive languages in terms of stress, and about the possible foot construction cross-linguistically. As mentioned earlier in this chapter, the weight of a CVC syllable hinges on its position in a given word. For example, in Arabic, a CVC syllable is considered heavy when it occurs in word-internal syllables by WBP, whereas it is considered light when it occurs in word-final syllables due to the presence of extrametricality. Angoujard (1990) and Kenstowicz (1994) posited that all modern Arabic dialects treat CVC syllables in non-final position as heavy syllables. Hayes (1995) stated that stress in quantity-sensitive languages is assigned to heavy syllables. However, CVC syllables in word-final positions fail to attract stress since the last segment is regarded as weightless by being extrametrical; for instance, in quantity-sensitive languages like English, Latin, and Arabic. Consider the following representation (2.21) of consonant extrametricality in the NNA word [dzir.bah] ‘a leather water bottle’:

(2.21) The Representation of Consonant Extrametricality in NNA



As shown in (2.21), the last consonant ⟨h⟩ is marked as an extrametrical segment (weightless), since it resides in the word-final position of the CVC syllable and fails to assign a mora through the WBP condition. Thus, the leftmost syllable attracts stress [ˈdzir.bah] because it counts as a heavy syllable (bimoraic). In relation to Arabic, including NNA, Hayes (1995) asserted that the rightmost consonant in a word-final CVC syllable is analysed as an extrametrical segment adjoined to the prosodic word node, which in turn is invisible to stress assignment. This interpretation implies that a final CVC syllable is equivalent to a CV syllable in terms of syllable weight. The following classification manifests the syllable weight of various internal versus final syllables, where the notation ⟨ ⟩ denotes that the consonant is ignored and considered as extrametrical (weightless) based on Hayes’ view (1995: 57), as in (2.22):

(2.22) The Weight of Final and Non-final Syllables

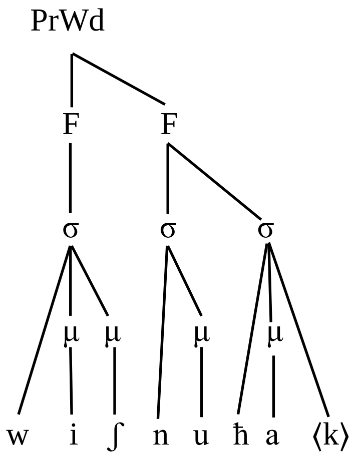
a. Final Position	**b.** Non-final Position	Syllable weight
CV	CV	light
CV⟨C⟩	CV	light
CVC⟨C⟩	CVC	heavy
CVV	CVV	heavy
CVV⟨C⟩	CVV	heavy

As can be seen in (2.22), the last consonant of final CVC, CVCC, and CVVC syllables is considered weightless. For instance, stress assignment provides compelling support for the weight distinctives between final and non-final CVC syllables, as in the NNA word [ˈʔar.widʒ] 'hurry up', where stress lodges on the penultimate heavy syllable. The placement of stress confirms that an internal CVC syllable is heavy by virtue of the WBP rule, and a final CVC syllable is light due to the presence of extrametricality, rendering the final consonant [dʒ] as an extrametrical segment. More to the point, a non-final CVC syllable may assign stress in the antepenultimate syllable, as in [mas.ˈdʒid.ham] 'their mosque', where the last consonant of the final syllable /m/ is deemed as extrametrical. It should be apparent that a final CVC syllable in NNA fails to assign stress, as in the previous example [ˈʔar.widʒ], where the penultimate syllable attracts stress rather than the ultimate syllable (stress assignment and foot construction in NNA will be discussed at length in Chapter Five).

Extrametricality can also be applied at the foot level, which renders a word-final foot extrametrical. Thus, extrametricality can be employed in a hierarchy and therefore a higher extrametrical element dominates a lower extrametrical element. Hayes (1995) stated that extrametricality does not chain due to the peripherality condition in a manner that a peripheral constituent blocks extrametricality. Yet, extrametricality cannot render a whole domain of stress rules as extrametrical due to the nonexhaustivity condition. An example is the NNA word

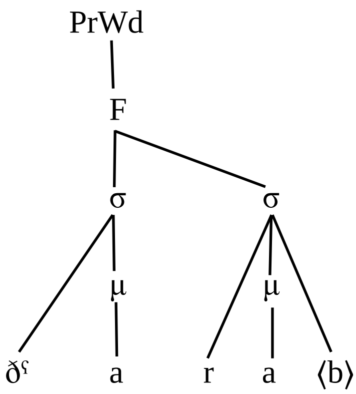
[ˈwiʃ.nu.ħi] ‘what’s my matter?’, where the peripheral rightmost foot (nu.ħi)is considered extrametrical. Hence, the presence of extrametricality is not limited to peripheral segments, but it can include the foot for the purpose of stress assignment and foot construction in a language. Thus, the rightmost foot is invisible to stress assignment. However, foot extramtericality can be blocked by an extrametrical segment, as in (2.23), where the extrametrical segment ⟨k⟩ depriving the whole foot from being extrametrical:

(2.23) Foot Extramerticality in NNA (Peripherality Condition)



As for the nonexhaustivity condition, foot extrametricality is blocked from applying in the sense that the peripheral foot is the only foot in the word. For instance, the NNA word [ˈðˤa.rab] ‘hit’ has only a single foot. Thus, foot extrametricality is inapplicable and the main stress is attached to the head of the foot (left-headed). Consider the following representation (2.24) of the foot extramerticality in NNA [ˈðˤa.rab], where the nonexhautivity condition is met:

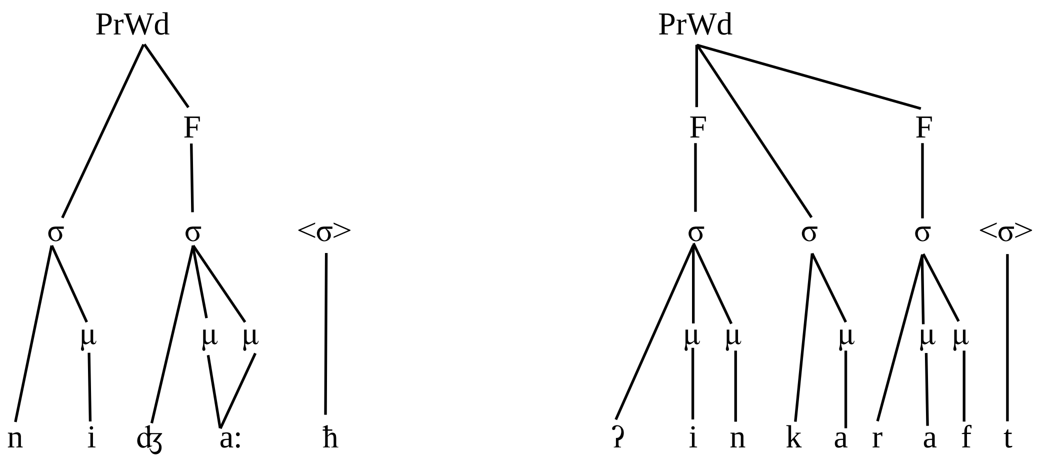
(2.24) Consonant Extrametricality in NNA (Nonexhaustivity Condition)



Unlike extrametricality, an extrasyllabic consonant is undominated by a higher constituent, i.e., a mora or a foot. Extrasyllabicity is not compatible with the notion of foot extrametricality in which the higher level constituents may dominate extrametrical lower level constituents. To be clearer, extrasyllabic segments deprive foot extrametricality from applying because these segments appear between the foot and the rightmost edge of the word (Hayes 1995: 106). Clements and Keyser (1983), Kenstowicz (1994), Hayes (1995), and Kager (1995) proposed diverse approaches to account for superheavy syllables in order to avoid violating the maximum weight per syllable condition, which is bimoraic, i.e., trimoraic syllables are forbidden in most Arabic dialects, including NNA. The last consonant of the canonical shapes CVVG, CVVC and CVCC is described as extrasyllabic, which is presented in phonology to account for certain stress system phenomena. This phonological rule is invoked when the foot is not peripheral, and it is blocked from being applied because the last consonant of CVVC and CVCC patterns occurs between the foot and the rightmost edge of the string (Hayes 1995: 107). In NNA, the final consonant of superheavy CVVC and CVCC syllables is treated as extrasyllabic; examples are the words [ni.ʤa:ħ] 'success' and [ʔin.ka.raft] 'I got tired' in NNA. These examples are represented in the following schematic form:

(2.25) The Representations of CVVC and CVCC in NNA

a. CVVC **b.** CVCC



As shown in (2.25a & b), the rightmost foot of CV.CVVC and CVC.CV.CVCC syllables violate the peripherality condition. That is to say, the rightmost feet of both representations (ʤa:) and (raf) are not peripheral, since the last consonants (stray consonants) /ħ/ and /t/ are positioned between it and the right edge of the string (Hayes 1995: 107). Consequently, the rightmost foot cannot be extrametrical due to the presence of the extrasyllabic consonants /ħ/ and /t/, in which they fall outside the syllable domain. In NNA, word-final superheavy CVVC and CVCC syllables are counted as heavy (bimoraic) followed by a degenerate foot[12] (Aoun 1979, Selkrik 1981, Kager 2007). Hayes asserted that chained extrametricality is excluded by the constraint expressed in (2.26) below:

(2.26) Extrametricality does not chain, i.e., a constituent followed by an extrametrical constituent is not counted as peripheral (Hayes 1995: 107).

Following the constraint in (2.26), the rightmost foot is deemed as non-peripheral. Thus, an extrasyllabic segment is not incorporated into the adjacent syllable as an extrametrical segment does.

2.6.2 Semisyllables and Mora Sharing

In this subsection, the last consonant of superheavy CVVC and CVCC syllables is no longer extrasyllabic or a degenerate syllable. The notion of semisyllables is invoked as an alternative proposal to extrasyllabicity to account for the domain superheavy syllables where the last consonant in coda clusters lies outside the syllable boundary. Thus, the last consonant is licensed as a semisyllable in a non-final superheavy syllable since it is moraic but unaffiliated to a syllable node (Kiparksy 2003). In this case, semisyllable segments would violate the SLH. Floating segments are counted as unsyllabified moras, which are ascribed to cross-linguistic features as quoted from Kiparsky (2003: 155) and presented in (2.27) below:

(2.27) The Characteristic Cross-linguistic Properties of Semisyllables

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 edges)
f. Prosodically invisible
g. Can be subject to minimum sonority requirement’

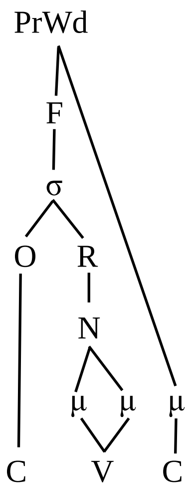
It can be inferred from the properties in (2.27) that semisyllables do not contribute to foot formation or stress assignment. This account can be shown in the following representations,

[12] Degenerate syllable means that a syllable may contain an empty nucleus or null vowel which is left unsyllabified at the end of the footed string (Hayes 1995).

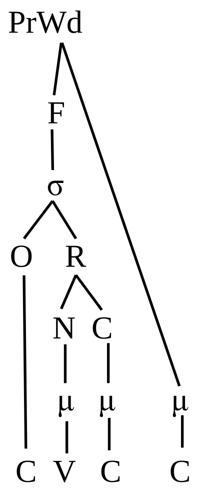
which illustrate the behaviour of semisyllables in non-final superheavy syllables, as in (2.28) below:

(2.28) Semisyllable Representations

(a) CVVC



(b) CVCC



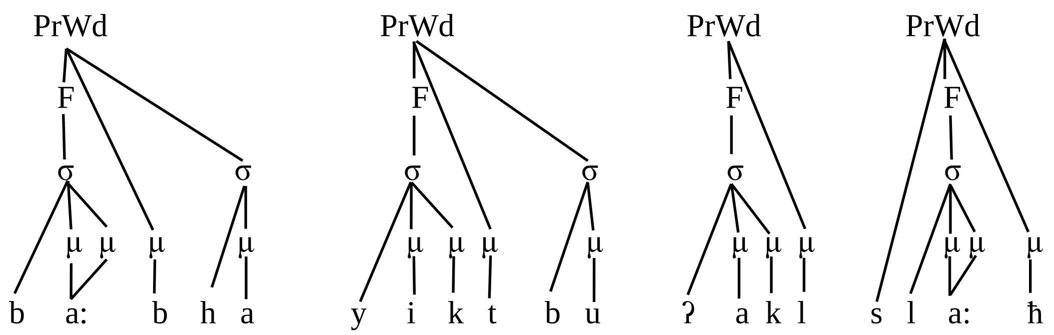
As illustrated in (2.28), the last consonants in both representations maintain their status as moraic and are directly linked to the prosodic word. In this case, they are analysed as semisyllables that are neither attached to a foot nor to a syllable because they do not satisfy the constraints of a syllable, foot binary, and SLH. In Arabic, a foot must contain no more than two moras of a heavy syllable or two light syllables. As a result, the last moraic consonants in the previous representations must be linked to the prosodic word to avoid violating such constraints.

Semisyllables behave differently in Arabic dialects. Kiparsky (2003) classified Arabic vernaculars into three groups, namely, VC-dialects, V-dialects, and CV-dialects, and highlighted how semisyllables in $CVVC_{\mu}$ and $CVV.C_{\mu}$ are tackled in these dialects (cf. Watson 2007: 337). These dialects can be distinguished by specific phonological processes[13]. (For more information about the three dialects, see Kiparsky 2003: 147-150, cf. Watson 2007: 339-340).

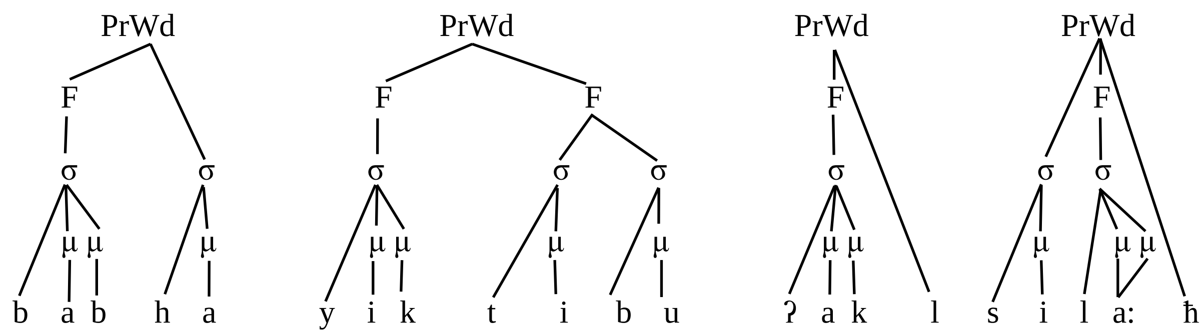
[13] C-dialects permit medial -CCC- clusters. However, NNA speakers insert a vowel after the second C in medial -CCC- clusters yielding -CCiC-, except when a verb plus the consonant-initial subject suffix /t/ is suffixed with the dative /l/, where medial -CCC- cluster are realised as in /gil-t-l-uh/ 'I said to him' → [gil.tluh] (more detail under the discussions in 4.2 and 4.9.2). This phonological process indicates that NNA has the same characteristic of a C-dialect. Kiparsky (2003) stated that in the North African C-dialects, the medial -CCC- clusters are either maintained without epenthesis, such as in (yilbsu, yiktbu) or pronounced with an epenthetic vowel either after the first C or the second C, such as in (yikatbu, yi:ktabu). These differences would not remove such dialects from C-dialects' category.

According to Kiparsky, we can infer that NNA belongs to C-dialects, since it shares almost the same features that C-dialects have[14]. C-dialects permit semisyllables at the word and postlexical levels. VC-dialects permit semisyllables only at the word level. In contrast, CV-dialects do not permit semisyllables at any level. The last consonant of the syllable shapes in CVVC and CVCC is moraless and linked directly to the prosodic word level. Consider the following representations (2.29) and (2.30) of semisyllables in the three dialects mentioned earlier, which is cited from Kiparsky (2003: 155-156):

(2.29) Semisyllables in VC- and C-dialects



(2.30) In CV-dialects, moras must be affiliated with syllables

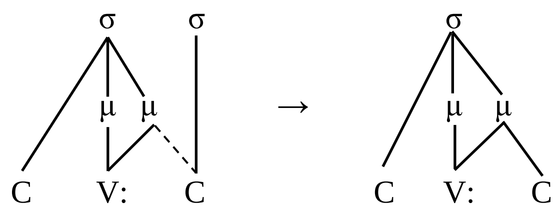


[14] The properties that classify NNA to C-dialects group can be generalised to all Najdi dialects which NNA belongs to (Al-ghizzi 2006, cf. Alhammad 2018). Al-ghizzi asserted that Najdi Arabic shares six characteristics that C-dialects entail, except for one feature, which is the possible coda clusters. Kiparsky (2003) pointed out that -CC coda clusters can occur unrestrictedly and can be split by inserting a vowel in C-dialects. This feature is not quite true for Najdi, including NNA in which they permit coda clusters, but with some limitations. Overall, missing some properties does not affect the classification of Najdi Arabic based on Kiparsky's view (more information about consonant clusters in NNA will be presented and discussed in the next chapter). All in all, I assume that NNA could be described as a CV-dialect with characteristics of C- and VC-dialects. To clarify, complex codas can be split by an epenthetic vowel in CV-dialects. This specification is found in NNA, as in /samn/ 'ghee'→ [sa.m**i**n]. Also, internal triconsonantal clusters are broken up by an epenthetic vowel after the second consonant in CV-dialects. For example, the NNA word /ja-ktb-u:n/ 'they (mas.) are writing' surfaces as [jak.t**a**.bu:n]. Complex onsets are permissible in VC- and C-dialects. This behaviour is revealed in NNA, such as /ndʒo:m/ 'stars' → [**ndʒ**o:m]. Initial geminates result from assimilation as found in NNA /t-ta:biʕ/ 'you (fem.) follow' surfaces as [**t:**a:.biʕ]. This feature belongs to VC- and C-dialects.

According to the representations above, various accounts of semisyllables in final and non-final positions are introduced, manifesting that VC- and C- dialects tolerate semisyllables to avoid trimoraic syllables. However, CV-dialects do not tolerate semisyllables and provoke vowel epenthesis to affiliate the semisyllable to a syllable node. Therefore, according to Kiparsky's analysis, the tolerance of non-final superheavy syllables coincides with the tolerance of semisyllables in all dialects.

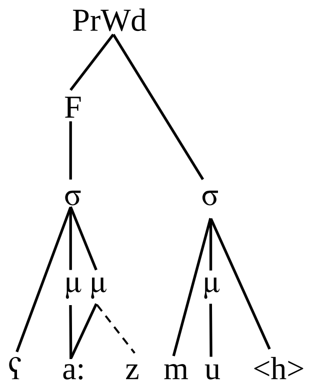
Mora sharing is another analysis of syllables containing long segments in many languages, including Arabic. This approach might be inapplicable with syllables ending in final consonant clusters when these clusters do not adhere to the Sonority Sequencing Principle (SSP). The concept of Adjunction-to-Mora or Mora Sharing was first introduced by Broselow (1992) and Broselow *et al.* (1995) to account for word-internal and final CVVC syllables in Arabic. Further, this concept can also be found in Malayalam, Hindi (Broselow *et al.* 1997), Bantu languages (Maddieson 1993, Hubbard 1995), and American English (Frazier 2005). Under the Mora-Sharing approach, the coda consonant in a CVVC syllable is directly attached to a syllable in which the coda is considered weightless to avoid trimoraic syllables. Thus, the final C in a CVVC syllable is assumed to share the rightmost mora with the previous vowel without adding its weight to the syllable (Broselow 1992: 14-15). Consider the following representation (2.31) that shows the Adjunction-to-Mora principle:

(2.31) Adjunction-to-Mora Representation



It is obvious that the rightmost mora dominates two segments (VC) in which the coda shares the mora with the preceding vowel. As a result, this syllable pattern obeys the syllable weight constraint, i.e., every syllable must be maximally bimoraic. In NNA, the notion of Mora Sharing cannot be employed to word-final CVCC syllables because the final C is deemed an extrasyllabic segment. Rather, Mora Sharing is applied to only word-internal CVVC and CVVG syllables (Watson 2007), such as [ʕa:z.muh] 'he invited him'. This example is shown in (2.32) below to show how mora sharing is implemented to avoid trimoraicity in the language:

(2.32) Mora Sharing in NNA



The internal CVVC syllable avoids trimoracitiy by sharing the mora with the preceding vowel. The foot is constructed over the heavy syllable (ʕa:) and the coda of the first syllable /z/ shares the mora with the rightmost vowel to avoid semisyllable and trimoraic syllables. The coda of the second syllable is marked as extrametrical. It should be noted here that the mora sharing rule can be applied to CVVG syllables in NNA (cf. Khattab and Al-Tamimi 2014 for similar proposal). That is, the potential trimoraic syllable is avoided by letting the geminate consonant shares the mora with the preceding vowel to preserve the bimoraicity status.

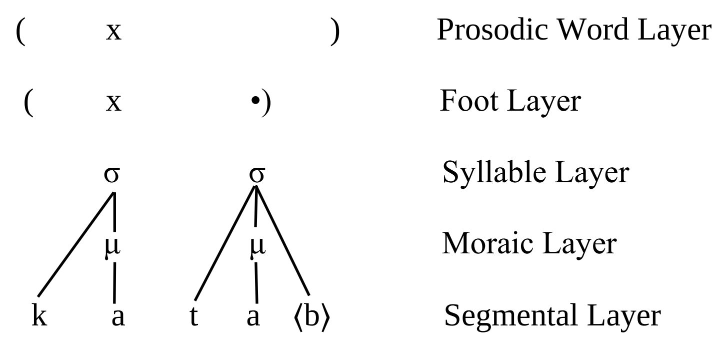
As mentioned earlier, the general concern lurking behind these proposals is the fact that superheavy syllables may violate the ban on trimoraic syllables. A full account of such proposals will be discussed in more detail in subsequent chapters. The next section will summarise Metrical Stress Theory, which is mainly adopted in the analysis of stress assignment and foot construction in NNA.

2.7 Metrical Stress Theory

Metrical Stress Theory was first introduced by Liberman (1975) as a response to Chomsky and Halle's (1968) proposal of a linear rule, which views stress as being segmental-based rather than rhythmic-based. Building on the prosodic theory presented earlier, the metrical theory of stress was developed later in the works of Liberman and Prince (1977) and Hayes (1981, 1984, 1995) to categorise stress and the typology of stress rules. This theory is interlinked with Moraic Theory of syllable structure and syllable weight. It should be noted that Metrical Stress Theory has been a distinctive characteristic in contemporary phonology, which is utilised as an analytical device to illustrate how stress systems function in a wide range of languages, including Arabic and its varieties.

Metrical Stress Theory is a sub-theory of generative phonology (non-linear approach)[15] that organises stress into a rhythmic or grid hierarchy in lieu of a segmental feature relating specifically to vowels (Liberman and Prince 1977). Hayes (1995) represented the metrical structure by bracketed grids in which a hierarchy of rhythmic beats is gathered into a hierarchy of entities. The hierarchy is formed from five layers within the grid, starting with the lower segmental layer and ending with the higher word layer: the segmental layer, the moraic layer, the syllable layer, the foot layer, and the word layer. Consider the following metrical structure representation of the Arabic word [ka.tab] 'he wrote' in (2.33), which is based on Watson (2002: 85), where parentheses indicate a foot, the (x) indicates stressed elements, while the bullet (•) indicates unstressed elements:

(2.33) Metrical Structure Representation



As can be seen in the representation of metrical structure in (2.33), the foot is constructed over the two light syllables [ka] and [ta]⟨b⟩. The consonant /b/ fails to receive a mora due to its extrametrical status. Hayes considered the foot to be the smallest metrical constituent in the hierarchy. The foot size may be either bounded or unbounded depending on the number of syllables. Bounded feet can house a fixed size of syllables or moras, while unbounded feet can house an unrestricted number of syllables or moras. According to Hayes (1995), three types of bounded feet are assumed: a syllabic trochee foot, an iambic foot, and a moraic trochee foot. In a syllabic trochee stress system, a foot is usually attributed to quantity-insensitive languages. It requires two syllables of indistinctive weight in which the stressed syllable is initial (head-initial). In a moraic trochaic stress system, a foot is attributed to quantity-sensitive languages. It is constructed from either two successive light syllables in which the stressed syllable is initial (head-initial), or a heavy syllable revives stress on its own. In an iambic stress system, a foot is

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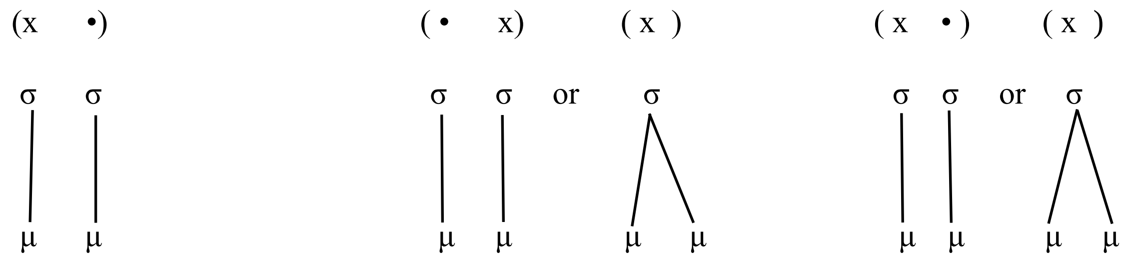
[15] In the SPE model, stress is addressed as a segmental feature and simply indicated as [+stress] for a stressed syllable and [-stress] for an unstressed phoneme (Chomsky and Morris 1968).

attributed to quantity-sensitive languages. It is constructed from one of three forms: two successive light syllables in which the final syllable bears stress (head-final), a heavy syllable revives stress on its own, or a light syllable followed by a heavy syllable in which the stressed syllable is final. These types of feet will be depicted in the following diagrams (2.34):

(2.34) Bounded Foot Types (Hayes 1995: 71)

a. Syllabic trochee **b.** Iamb **c.** Moraic trochee



As presented in (2.34), a convenient foot structure should be disyllabic (two light syllables) or a heavy syllable (bimoraic), in which it is parsed into one foot. Parsing is a basic principle in the theory, and it is utilised as the mechanism by which syllables are grouped into feet.

Hayes (1995: 2-3) stated the fundamental theoretical aspects of the theory, which can be summed up as follows:

a. ‘The basis of the foot inventory is a principle called the Iambic/Trochaic Law[16], which forms part of the theory of rhythm, not of language proper. The Iambic/Trochaic Law determines the set of possible feet and motivates a large number of segmental rules that adjust metrical structure.

b. Metrical structure creation is non-exhaustive; that is, it needs not exhaust the strings of syllables.

c. Many stress languages impose a ban on ‘degenerate’ feet[17], that is, feet that consist of a single mora in languages that respect quantity, feet of one syllable in languages that do not.

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[16] Hayes (1995-80) illustrates the Iambic/Trochaic Law principle as a law of well-formed rhythmic structure, which can be summarised as follows:

a. Elements contrasting in intensity form groupings with initial prominence.
b. Elements contrasting in duration naturally form groupings with final prominence.

[17] Hayes (1995) stated that a ban on degenerate feet is uneven, depending on language-specific parameters, in which it can be strongly forbidden or weakly forbidden.

d. Syllable weight is not a unitary phenomenon; instead, languages distinguish between syllable quantity and syllable prominence. Quantity is represented by mora count, while prominence may be based on many other properties of the syllable and is formally represented with grid columns of varying height. Only quantity may be referred to by rules of foot construction while prominence may be referred to by other metrical rule types, for example end rules and destressing'.

Furthermore, Hayes (1995) applied the term 'End Rule' (Left/ Right) in stress assignment, which was first formulated by Prince (1983). This rule applies at the top of the grid and places an extra mark creating the head of a constituent, whether to the leftmost or rightmost element. In NNA, for instance, foot parsing proceeds from left to right and the word layer rule is apparent as an example of End Rule Right (ERR), moderated by syllable extrametricality. ERR is a tool that assigns stress to the rightmost visible foot in a phonological word. Further details about this theory and its applications will be provided later in Chapter Five.

It should be noted that the tenets and parameters of the metrical stress theory will be adopted (particularly in Chapter Five) in order to elucidate the various properties of stress system and foot construction in the understudied dialect.

After presenting the relevant theories and principles in the current study, these theories and principles will be translated into specific constraints that suit our analysis throughout the thesis under the framework of Optimality Theory (OT). In the next section, I will provide an overview of OT, which is the core framework for the analysis of various phonological phenomena in the current study.

2.8 Optimality Theory

Optimality Theory (OT) was introduced to the field of phonology by Prince and Smolensky (1993/2004). Before it was formally published, this manuscript had a lasting impact on the field of phonology. A decade later, their work was officially published and widely distributed as Prince and Smolensky (2004). After that, OT has continued its influence not only on phonology, as its impact has extended to other linguistics' fields such as sociolinguistics, syntax, and semantics (McCarthy 2008: 1). OT is utilised as an alternative approach to the rule-based model, such as those in the SPE (Chomsky and Halle 1968), to analyse various linguistic features. OT is able to account for phonological conspiracies with a coherent and non-arbitrary set of mechanisms (Cassimjee and Kisseberth 1999).

OT eliminates the rule-based model and suggests that the link between an underlying form and its surface form is not derivational. Rather, OT suggests that underlying forms are connected directly to surface forms through parallel evaluation by a set of violable constraints. The mechanism of OT is merely recognised as a relation held between input and output in which each input has an accurate output (McCarthy 2008). For any given input, the machinery of OT constitutes two important stages in any grammar. First, the generator (GEN), which generates an infinite list of possible candidates (outputs) for a given input. These candidates are logically possible analyses of an input. Second, the evaluator (EVAL) in which a set of constraints scan the candidate set to designate the wellformedness of a possible output for a given input form. Consequently, only one output will best satisfy these constraints and be selected as an optimal or the most consistent candidate (Kager 1999). The interaction between these machineries is diagrammed in (2.35) below:

(2.35) Diagram of Optimality Theory

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

The constraints in OT are violable but permit the minimal costly violation of the constraints in which they can be determined by their hierarchical ranking. The ranking of some constraints is preferred over others in certain languages. Accordingly, higher-ranked constraints must be respected, and lower-ranked constraints can be violated to prevent the violation of higher-ranked ones. OT constraints are in a relationship of strict domination in which 'violation of higher-ranked constraints cannot be compensated for by satisfaction of lower-ranked constraints' (Kager 1999: 22). As a result, candidates which violate high-ranking constraints are quickly ruled out because they incur a greater cost to a relative well-formedness constraint as opposed to the violation of low-ranking constraints (Kager 1999: 8-9). It should be noted that the ordering relationship is conventionally symbolised with >>, such as C1 >> C2 >> C3. This order is a transitive relationship in which the C1 is the highest ranked constraint/undominated, which dominates the subsequent constraints C2 and C3. The C2 dominates the C3, and the C3 is a low-rank constraint that does not dominate any constraint. More to the point, satisfaction of C1 is more important than satisfaction of C2, and satisfaction of C2 is more important than satisfaction of C3. It is worth mentioning that the constraints of OT are supposed to be universal and active in all human languages; however, their ranking can be related to the differences between languages. Consider the following tableau (2.36) showing the interaction between C1, C2, and C3:

(2.36) An Illustrative Tableau of OT, /y/ → [f].

C1, C2 >> C3

Input: /y/	C1	C2	C3
☞ a. [f]			*
b. [n]	*!	*	
c. [z]		*!	*

As shown in the tableau (2.36), the input is /y/, whilst the candidates (outputs) are [f], [n], and [z]. During the process of evaluation, the grammar evaluates the outputs and then selects the optimal form. It can be observed that candidate (a) is selected as the optimal form because it respects the high-ranked constraint C1, and it displays a minimal violation of the low-ranked constraint C3. Candidate (b) is ruled out due to the violation of the higher/undominated constraint C1 and C2. Candidate (c) loses the competition because it incurs two violations: the high-ranked constraint C2 and the low-ranked constraint C3. Yet, the asterisk mark * indicates a violation of a relevant constraint. However, if the asterisk mark is accompanied by exclamation marks *!, this means that the violation is fatal and it is responsible for eliminating a certain candidate. Shaded cells indicate that any violations would have no impact on the outcome because higher-ranking constraints are decisive.

OT categorises universal constraints into three families: markedness constraints, faithfulness constraints, and alignment constraints. Markedness constraints deal with certain structural configurations and require universal tendencies; for example, ONSET indicates that languages tend to ban onsetless syllables. Faithfulness constraints require outputs to be identical to inputs, such as DEP-IO and MAX-IO. To clarify, DEP-IO prohibits epenthesis and MAX-IO prohibits deletion (McCarthy 2008: 24). Alignment constraints are implemented to confirm structural alignment between various linguistic structures; for example, the constraint RIGHTMOST ensures that the right edge of a word corresponds with the right edge of a syllable. Overall, constraints should be arranged in an efficient order to obtain a cogent explanation of such phonological aspects in a language.

2.9 Summary

This chapter's primary objective was to highlight the main phonological theories that are mostly adopted in the analysis of the phonological phenomena in NNA where relevant throughout the thesis. The chapter began with a discussion about the significance of the syllable in phonological theory. Two different perspectives were then introduced regarding the role of the syllable in phonological theory in general. Some scholars have denied the notion of the syllable in their work and have appealed to a linear rule model when analysing phonological aspects, i.e., the SPE model, which is the traditional framework in generative phonology (Chomsky and Halle 1968). On the other hand, the proponents of the concept of the syllable (Hooper 1972, Khan 1979, among others) have stated that some phonological processes cannot be addressed without referring to the syllable.

It was noteworthy to briefly introduce the two theories in relation to syllable weight before focussing on the theories adopted in this study. First was the CV Theory presented by Clements and Keyser (1983), among others. This theory distinguishes between vowels and consonants by identifying whether the segment is linked by a C or a V node. The notion of the syllable continued to be a cornerstone in manifesting syllabic weight, which triggered a wide range of phonological phenomena. The most seminal studies are those of Halle and Vergnaud (1980) and Levin (1985) in which they replaced the CV-tier with X-slots. These slots may attach to either a consonant or a vowel. Later, Hayes (1989) brought to the field the most outstanding work proposing a new notion termed as ‘mora’ to measure syllable weight. Light syllables are assigned a single mora (monomoraic), whereas heavy syllables are assigned two moras (bimoraic). However, superheavy syllables are trimoraic since they are assigned three moras, which is infrequent across languages (Hayes 1989: 291). The diverse syllable weights cannot be generalised cross-linguistically because they are language-specific. It can be noted that a mora is a reliable unit of prosody that makes a neat distinction between light, heavy, and superheavy syllables. Overall, in this study, various syllable patterns involving geminates were analysed within Moraic Theory to account for diverse phonological generalisations in NNA.

The concept of word minimality (content words) was introduced based on the prosodic hierarchy, starting from the prosodic word and ending with the mora level. Likewise, each content word must minimally contain a foot, and a legitimate foot can only be maximally disyllabic and minimally bimoraic (McCarthy and Prince 1986). If these conditions are violated, other rules are invoked in order to avoid trimoraic syllables.

With regard to stress assignment and foot construction, an overview of Metrical Stress Theory was given in this chapter. Metrical Stress Theory is a sub-theory of generative phonology (non-linear approach) that organises stress into a rhythmic or grid hierarchy in lieu of a segmental feature relating particularly to vowels (Liberman and Prince 1977). Hayes (1995) illustrates the metrical structure by bracketed grids in which a hierarchy of rhythmic beats is gathered into a hierarchy of constituents. Hayes considers the foot to be the smallest metrical constituent in the hierarchy. The foot size may be either bounded or unbounded depending on the number of syllables it entails. Bounded feet can house a fixed size of syllable or moras, while unbounded feet can house an unlimited size of syllable or moras. According to Hayes, there are three types of bounded feet: a syllabic trochee foot, an iambic foot, and a moraic trochee foot. In a trochaic stress system, a foot refers to a disyllabic or bimoraic in which the stressed syllable is initial. In an iambic stress system, a foot refers to a disyllabic or bimoraic in which the stressed or prominence syllable is final. In a moraic trochee stress system, a bimoraic syllable is grouped into a foot. Hence, a heavy syllable revives stress on its own and the two consecutive light syllables in which the first syllable receives stress. This theory was implemented in the analysis of stress assignment and foot construction in NNA. Finally, the basic tenets of Optimality Theory were offered in this chapter, since it is couched as the framework in the analysis of phonological phenomena in an understudied dialect throughout the thesis.

Chapter 3. Syllable Structure and Syllabification in NNA

3.1 Introduction

Syllable structure and syllabification of Arabic have attracted many phonologists' attention for more than two decades, (see Abu-Mansour 1987, 1995, Broselow 1992, Abaalkhail 1994, 1998, Zawaydeh 1997, Watson 2002, 2007, Kiparsky 2003, Bamakhramah 2009, Alqahtani 2014, Alahmari 2018, and Alhuwaykim 2018). This chapter is of particular significance since it establishes syllable structure types and syllabification patterns of Northern Najdi Arabic (NNA) a variety of Arabic that no previous study has tackled. This would contribute to the field of Arabic phonology in general and to Arabic syllable structure and syllabification in particular. As the preceding discussion in Chapter Two indicates, segments are gathered into syllables in which these syllables form various syllable structure shapes. These syllable shapes may undergo various syllabification processes to examine syllable well-formedness requirements with respect to some universal and/or language-specific constraints. Furthermore, the syllabification patterns play a crucial role in capturing numerous phonological generalisations of individual languages. Carr (1993:199) posited that most phonological processes are best explained with reference to syllable structure and syllabification, e.g., vowel epenthesis or vowel deletion.

The essential objective of this chapter is to examine and analyse the novel data of syllabification patterning of word-final and non-final heavy and superheavy CVC, CVG, CVVC, CVCC, and CVVG syllables. Most Arabic varieties follow the grammar of Classical Arabic in avoiding word-internal superheavy syllables and applying some repair strategies, such as vowel epenthesis or vowel shortening in order to preserve the bimoraicity status in each syllable. This is not always the case, however, since some Arabic varieties allow internal-word superheavy syllables. For instance, in the Attuwair dialect, a variety spoken in North-western side of Saudi Arabia, non-final CVCC, CVVC, CVVG syllables are permitted, such as /ʃil-t-l-ah/ 'I carried for him' surfaces as [ʃilt.lah], /ʕa:m-ha/ 'her year' surfaces as [ʕa:m.ha], and /raad:-l-hum/ 'returning to them' surfaces as [raad:.lhum]. Thus, trimoraic syllables are retained in the surface forms, and no repair strategies are employed to avoid such syllables. Regarding syllable weight under moraic theory, the final consonant of CVVC, CVCC syllables or the final geminate consonant of CVVG syllables behave differently in word-final position in order to avoid the violation of trimoraicity constraint in NNA. However, word-internal superheavy CVVC, CVCC, and CVVG syllables can be both avoided and sometimes permitted in the understudied dialect, whereby the final consonant or geminate are always treated differently to motivate the outright ban on trimoraic syllables.

The remainder of this chapter is organised as follows: section 3.2 provides the source of underlying forms in the investigated dialect. Section 3.3 elaborates the notion of syllable structure and introduces an overview of syllable structure types and their distribution in CA along with NNA in the subsequent subsections. Section 3.4 and its subsections discuss the syllabification patterns and the behaviour of heavy and superheavy syllables in final and non-final word positions based on moraic theory. Also, they show how these syllables are treated in some varieties of contemporary Arabic, and then particularly in NNA. After that, the last subsections deal with the avoidance of superheavy syllables in word-internal position through some phonological processes, which are sensitive to syllabification. Section 3.5 develops an analysis couched in the framework of Optimality Theory (OT) to account for final and non-final CVC syllables in the dialect. This should be followed by an OT analysis for superheavy CVVC, CVCC, and CVVG syllables in word-internal and word-final positions and the avoidance of some superheavy syllable structures when they occur word-internally. Finally, section 3.6 provides a synopsis of the main points and findings in the chapter.

3.2 Selecting the Underlying Form in NNA

There is a relation that mediates between the underlying and the surface forms in which they refer to the notion of ‘the underlying-surface correspondence’. Under OT perspectives, the underlying forms solely equals or approximates to the surface forms, except if there is a reason to diverge due to what is called ‘Lexicon Optimization’. This concept alludes that the selected input should be the one that maps onto the output with the minimum faithfulness violations (Kager 1999: 414, Kim 2002: 34-35). On that account, in the current study, the underlying forms are taken from NNA grammar. Therefore, some NNA underlying representations map onto NNA surface representations, such as /dʒsu:r/ ‘bridges’ yielding as [dʒsu:r] and /ħza:m/ ‘belt’ yielding as [ħza:m]. This denotes that the underlying forms are similar to the surface forms, and no phonological processes are applied in order to obtain the surface forms unless there is a reason for utilising alternative forms. More to the point, any underlying form should be examined with diverse morphological forms to make sure they are invariable across related forms. For the purpose of investigating word edge clusters in NNA, I examined the underlying form /dʒda:r/ 'wall' with related forms, as in /dʒda:r-ah/ 'her wall', /dʒda:r-uh/ 'his wall', and /dʒda:r-i/ 'my wall', yielding [dʒda:r], [dʒda:.rah], [dʒda:.ruh], and [dʒda:.ri], respectively. Also, the underlying form /ħilm/ 'dream' is examined with related formsm, as in /ħilm-ah/ 'her dream', /ħilm-uh/ 'his dream', and /ħilm-i/ 'my dream', yielding [ħilm], [ħil.mah], [ħil.muh], and [ħil.mi], respectively. I revealed that complex onsets and codas occur underlyingly in these forms. For the purpose of attesting the syllabification of superheavy syllables word-internally, the underlying representation /tˤa:lib-ah/ 'female student' and /tˤa:lib-uh/ 'his student' are realised as [tˤa:l.bah] and [tˤa:l.buh] after suffixation. Thus, there is an underlying high vowel [i] in the underlying representations and this vowel is syncopated in the surface forms in the dialect.

In the next section and the subsequent subsections, I will introduce an overview of syllable structure, followed by insights about the syllable structure forms of Classical Arabic and NNA and their distribution.

3.3 Syllable Structure

Syllable structure is assigned to a string of permissible segments that function as a unit. This string often stems from a combination of consonants and/or vowels. The syllable structure is influenced by two factors: the arrangement of segments in the flat string and their sonority with regard to their neighbours (Hannahs and Bosch 2018: 263). Maximally, the syllable consists of an onset, nucleus, and coda. Minimally, it consists of a nucleus (Reetz and Jongman 2009). Cross-linguistically, the nucleus is an unavoidable constituent and thus a compulsory segment in all syllables (Cairns and Raimy 2011). Therefore, it is not striking that the syllable is built outward from the nucleus. Universally, the most primitive syllable inventories are CV, V, CVC, and VC sequences (Clements and Keyser 1983, Kenstowicz 1994). Nonetheless, it should be noted that syllable structure is a language-specific property. That is, some languages require onsets but not codas, and some languages permit onsetless syllables but not others. Further, some languages permit both complex onsets and codas and others permit only one of them. On the other hand, some languages prohibit consonant clusters within the margins. For instance, complex onsets are not allowed in Cairene Arabic, such as in [kibi:r] 'big', but they are allowed in Syrian and Jordanian Arabic, such as in [**kb**i:r]. More to the point, complex codas are permissible in Egyptian dialects and Moroccan Arabic, but they are illicit in Eastern Libyan Arabic. For example, the Cairene Arabic word [kalb] 'dog' is realised as [kalib] in Eastern Libyan Arabic (Benmamoun and Bassiouney 2017: 34). It is highly favoured that the syllable begins with a consonant and ends with a vowel (Kager 1999). Therefore, there is a wide consensus among most researchers confirming that the light CV syllable is a core syllable and deemed as an absolute universal syllable structure across spoken languages (Carlisle 2001: 2).

Alezetes (2007) and Alqhatani (2014) pointed out that if a language allows complex onsets and codas, it will certainly allow simple onsets and codas. The presence of an onset is primary in some languages; however, no languages require the existence of a coda in a syllable. So, in order to specify a syllable division, sometimes we appeal to the principle of 'onset maximisation'. This principle dictates that some languages prefer onsets over codas due to the significance of onsets in the syllabification process. To illustrate, intervocalic consonants should be syllabified as onsets when there is no violation of the sonority hierarchy hold. Hence, there is a propensity for consonants to be syllabified as onsets rather than codas. For example, as a cross-linguistic generalisation, VCV tends to be syllabified as V.CV rather than VC.V. Likewise, this principle can be applied to the syllabification of intervocalic clusters, as in VCCV sequences are syllabified as V.CCV rather than VC.CV, if the onset cluster is licit in the language in question (Kavitskaya and Babyonyshev 2011: 359). For example, the word 'diploma' in English, the syllable boundary lies before /p/ in which it becomes the onset of the second syllable [di.plo.ma] (Kahn 1976). However, this principle cannot be generalised universally. To illustrate, the pair of words 'apply' and 'frantic' are syllabified differently with respect to the onset maximisation principle. The syllable boundary of the first word lies before the /p/ and the /l/ in which they form the onset of the second syllable [ə.plaɪ]. On the other hand, the syllable boundary of the second word lies between the two consonants /n/ and /t/ yielding [fran.tic]. The question then arises over as to why the first word applied the principle of onset maximisation, but not the second one. The answer is that the sequence of [pl] is licit complex onset but [nt] is not in English. Consequently, it should be taken into consideration that not all medial consonants are syllabified as onsets in which these phonotactic constraints are highly language-specific (Davenport and Hannahs 2010).

Davis and Baertsch (2011: 71) posited that there are no reciprocal relations held between onsets and codas. To elaborate, 'if a language requires onsets, it does not ban or require codas, and vice versa' (Zec 2007: 164). On the other hand, Kaye and Lowenstamm (1981) stated that the existence of a complex onset in a language alludes to the existence of a coda in that language. However, very few languages have CCV syllables and lack CVC syllables. In contrast, if a language permits codas, it may or may not permit onset clusters.

Before embarking on the discussion of syllabification mechanisms in NNA, it is worthwhile to begin with a background of the syllabic structure in CA. The next subsection is followed by a detailed account of the syllable structure in NNA.

3.3.1 The Syllable Structure of CA

The syllable structure of Arabic has been investigated extensively in the relevant literature (Al-Ani 1970, Broselow 1979, McCarthy 1979, 1980, Abu-Salim 1982, Watson 2002, to name but a few). Most scholars confirmed that there are a limited number of possible syllable forms in CA (Watson 2002, Ryding 2005, among others). These syllables are either open when a syllable ends with a short or a long vowel, such as CV and CVV or closed when a syllable ends with a simplex, a complex coda, or a geminate, such as CVC, CVCC, CVG, and CVVG. Syllable structure is confined to the following combination of consonants and vowels, and it mainly falls under three categories based on their weight (cf. Hamdi *et al.* 2005: 2245, Chentir *et al.* 2009: 1, AlAmro 2016: 376, Bamakhramah 2009: 28-29, Alqahtani 2014: 40-41). The following order in (3.1) exemplifies the possible syllable inventories in CA:

(3.1) The Syllable Types and Distributions in CA

1. Light syllable:

- CV: is formed from a consonant which serves as an onset and a short vowel which serves as a nucleus; for example, the word [**ra.sa.ba**] ‘he failed’. This syllable type is unrestricted on its occurrence. Thus, it occurs freely in word-initial, medial, and final positions.

2. Heavy syllables:

- CVV: is composed of a single consonant which occupies the onset position and a long vowel which occupies the nucleus position. This pattern occurs freely word-initially, as in [**sa:**.ħir] ‘magical’, word-medially, as in [saj.ja:.**ra:**.ti] ‘my cars’, and word-finally as in [da.**ʕa:**] ‘he calls’.
- CVC: is formed from one consonant in the onset position, a short vowel in the nucleus, and one consonant in the coda position. This type occurs in all word positions: word initially, as in [**ʔim**.ti.ħa:n] ‘exam’, medially, as in [ða.**hab**.na:] ‘we went’, and finally, as in [ka.**tib**] ‘writer’.

- CVG: it consists of a single consonant in the onset position, a short vowel in the nucleus, and a geminate in the coda position. This type occurs in all word positions: word initially, as in [**kas**.**s**ar] ‘he smashed’, medially, as in [ju.**dar**.**r**is] ‘he teaches’, and finally as in [dam:] ‘blood’.

3. Superheavy syllables:

- CVVC: it contains a single consonant in the onset position, the rhyme is filled by a long vowel, and the coda position is filled by a single consonant, such as [**ba:b**] ‘door’. This shape only occurs word-finally but not initially and medially.
- CVCC: it constitutes one consonant which serves as an onset, a short vowel as a nucleus, and a double consonant serves as the coda, such as in [**baħr**] ‘sea’. The allocation of the superheavy CVVC and CVCC syllables is confined to occur in a word-final position as a monosyllabic word (Abaalkhail 1998: 92, Jarrah 2013: 6, AlBzour 2015: 187).
- CVVG: it has one consonant which serves as an onset, a long vowel in the rhyme, and a double consonant (a geminate) in the coda position, such as in [**ħa:d:]** ‘sharp (mas. sg.)’. The allocation of superheavy CVVG syllables is limited to appear in word-final position (AlAmro 2016: 376, Alqahtani 2014: 40-41).

As it can be noted from (3.1), the syllable structure of CA constitutes one light syllable, three heavy syllables, and three superheavy syllables. All syllables require at least one vowel; however, the distribution of vowels is restricted. Vowels can only occur between two consonants in a closed syllable or at the end of an open syllable. More importantly, there are two constraints that pertain to the configuration of CA syllable structure. First, no syllable may begin with a vowel. Thus, onsets are obligatory, and codas are optional constituents, as found in open syllables like CV and CVV syllable patterns. Second, no syllable may begin with a biconsonantal cluster. Thus, initial biconsonantal clusters are proscribed, whereas biconsonantal coda clusters are permitted, as in CVCC (Watson 2002: 51-67). Al-Ani (1970: 87) stated that the superheavy syllable of the form CVVG, where the last two consonants are a geminate, rarely appears in CA and is confined to domain-final position in monosyllabic words, such as [ʒa:d:] ‘serious’. In general, the most prevalent syllable types are CV, CVC, and CVG because these syllables are considered as unmarked in CA and can freely occur word initially, medially, and finally. The distribution of a CVV form is partially marked since it appears word initially and word medially but not word-finally.

The least prevalent syllable structures are CVCC and CVVC. These syllable shapes are assumed to be marked in CA because they are restricted to occur in domain-final position. The following table summarises the syllable structure shapes in CA, as is shown in table (3) below (cf. Chentir *et al.* 2009: 2)

Table 3: Syllable Types in CA

Syllable type	Initial	Medial	Final	Weight
CV	[**ra**.sa.ma] 'he draws'	[ʃa.**ri**.ba] 'he drank'	[ʒa.la.**sa**] 'he sat'	light
CVV	[**ħa:**.qid] 'spiteful'	[ju.**ta:**.biʕ] 'he follows up'	[jan.**ʕa:**] 'he mourns'	heavy
CVC	[**ʔiz**.ʕa:ʒ] 'disturbance'	[ʒa:.**hil**] 'ignorant'	[mal.**ʕab**] 'playground'	heavy
CVG	[**daʒ.ʒ**a:l] 'juggler'	[mu.**dar**.**r**is] 'teacher'	[ra**d:**] 'response'	heavy
CVVC	----------	----------	[**qa:m**] 'he stood up'	superheavy
CVCC	----------	----------	[**tamr**] 'dates'	superheavy
CVVG	----------	----------	[**ʒa:d:**] 'serious'	superheavy

Ryding (2005: 35) noted that a prosthetic glottal stop /ʔ/ is augmented before a phrase-initial vowel and before vowel-initial loanwords. That is, the glottal stop prosthesis is called for as a repair strategy to facilitate the pronunciation and to satisfy the syllable structure constraints found in the grammar of CA (i.e., onsetless syllables are forbidden). For example, if the Arabic words /is.lam/ 'Islam' → [**ʔ**is.lam] and /iʕ.lam/ 'media' → [**ʔ**iʕ.lam] start with a vowel-initial syllable, the glottal stop is inserted which serves as an onset of the initial syllable in order to coincide with the syllable structure rules of CA. Furthermore, this phonological process can be extended to non-Arabic words beginning with a vowel. To illustrate, non-Arabic words or English loanwords that have vowel-initial syllables are repaired by inserting the glottal stop /ʔ/ initially when pronounced by Arabic native speakers. Thus, the glottal stop /ʔ/ serves as an onset in an initial syllable, such as the non-Arabic word /əmerikə/ 'America' → [**ʔ**am.ri.ka] and /æsi:d/ 'acid' → [**ʔ**a.si:d] (Prince and Smolensky 1993/2004, Watson 2002).

To recap, CA constitutes six syllable types, and they are divided into three groups: light, heavy, and superheavy. CA neither allows complex onsets nor onsetless syllables. This means that onsets are obligatory, and onsetless syllables are prohibited. Simple and complex codas are licit, and they are optional since some syllable patterns end with either a short or a long vowel, such as CV, CCVV, and CVV. However, if a syllable begins with a vowel, a glottal stop /ʔ/ is prosthesised in order to obviate vowel-initial syllables, which are forbidden in the grammar of CA.

3.3.2 The Syllable Structure of NNA

Generally speaking, there are some commonalities between CA and NNA in terms of syllable structure inventories. Nevertheless, Arabic varieties including NNA, allow more syllable structure types compared to CA (Alezetes 2007: 63). The syllable structure of NNA can be categorised into three groups based on their weight, as it is presented in (3.2) below:

(3.2) The Syllable types and Distribution in NNA

1. Light syllables

- CV: it constitutes a singleton onset and a vowel in the nucleus position, as in [**si**.ga] 'he watered'. The distribution of this syllable occurs freely initially, medially, and finally.

- CCV: it constitutes an initial consonantal cluster and a single vowel in the nucleus position, as in [**dwa**] ‘medicine’ and [ʤib.**tl**ah] ‘I brought to her’. It occurs in all word positions: initial, internal, and final.

2. Heavy syllables:

- CVC[18]: it constitutes a singleton onset consonant, a single vocalic segment in the nucleus, and a consonant in the coda position; for example, [**ʔin**.θi.**bir**] ‘keep calm (mas. sg.)’. It is distributed freely in a word: initially, medially, and finally.
- CVV: it is composed of a consonant in the onset position and a long vowel in the nucleus position; for example, [**ta:**.ʤir] ‘trader’. It can appear both word-initially and internally but not word-finally.
- CCVC: it is composed of a double consonant in the onset position, a short vowel in the nucleus position, and a single consonant in the coda position; for example, [**nχal**.tuh] ‘his palm tree’ and [ra:.**ħlah**] ‘he went to her’. It can appear both word-initially and finally but not word-internally.
- CCVV: it is composed of an onset cluster and a long vowel in the nucleus position; for example, [**sba:**.ħah] ‘swimming’. The CCVV sequence is strictly found in word-initial position.
- CVG: it contains a singleton onset consonant, a short vocalic segment, and a long consonant (a geminate); for example, [**ʔam:**] ‘uncle’ and [**ʔam**.**m**a.ham] ‘their (mas.) uncle’. The distribution of this syllable form freely occurs in a word: initially, medially, and finally.

3. Superheavy syllables:

- CVVC: it consists of a consonant in the onset position, a long vowel in the nucleus position, and a consonant in the coda position, such as [na:m] ‘he slept’. The distribution of this type occurs in all word positions: initially, medially, and finally.

[18] This type of syllable structure can be treated as light in NNA when it appears word-finally (recall the WBP rule in 2.14, which is proposed by Hayes 1989). In this stage, I present an overview of syllable types without implementing moraic theory and its parameters. As mentioned earlier, this theory will be adopted in the analysis throughout the thesis where needed.

- CVCC: it contains a consonant in the onset position, a short vowel in the nucleus position, and a coda consonant cluster, such as [dirʤ] 'drawer'. This type of syllable structure is confined to only occur word-finally.
- CCVVC: it consists of an initial cluster, the nucleus is filled by a long vowel, and a singleton coda, such as [ħma:r] 'donkey'. It is limited to occur in word-final position.
- CCVCC: it consists of an initial cluster, a vowel in the nucleus position, and a biconsonantal coda cluster, such as [jħalf] 'swear (mas.)' and [ʔin.tχibt] 'I was elected'. The distribution of the CCVCC syllable pattern is strictly found in word-final position.
- CVVG: it is composed of a consonant in the onset position, a long vocalic segment in the nucleus position, and a geminate consonant, such as [ha:m:] 'important'. This type of syllable structure is limited to only occur word-finally.

As shown in (3.2), it can be observed that some syllable structure features of NNA and CA are related to each other, with some additional properties found in the understudied dialect. To clarify, NNA constitutes twelve syllable types with three different syllable weights: light, heavy, and superheavy. These syllable structures can be either open or closed syllables. The light syllables are open ending with a short vowel, as in CV and CCV. The heavy syllables involve two open syllables ending with a long vowel, as in CVV and CCVV, and three closed syllables ending with a singleton coda or a geminate consonant, as in CVC, CVG, and CCVC. The superheavy syllables include only closed syllables ending with either a single coda, a complex coda, or a geminate consonant, as in CVVC, CVCC, CCVVC, CCVCC[19], and CVVG. All syllable canonical shapes presented earlier are found in monosyllabic and multisyllabic words.

It seems clear that all syllable patterns require single onsets since onsetless syllables are not allowed, whilst codas are optional since open syllables lack codas, as in CV and CVV. Complex onsets and codas are tolerated up to two consonants, as in CCV and CVCC. It can be obviously seen that all syllable shapes begin with an onset cluster that may differ in their occurrence. For example, CCV occurs word-initially, word-medially, and word-finally, but CCVVC only occurs in word-final position. NNA syllable structure can have both complex onsets and codas within the same syllable, as in CCVCC (cf. Ingham 1994). According to Abboud (1979: 498), the syllable boundaries are highly predictable in NNA. To clarify, in a string of VCV, the

[19] This type of syllable is mostly found in monosyllabic words, but it is very rarely found in polysyllabic in the dialect.

syllable division falls before the consonant, and in VCCV, the syllable boundary falls between the two consonants.

Regarding syllable structure, Ingham (1994: 20-21) contended that Najdi Arabic (NA) preserves the primary features of CA in accepting non-final syllable shapes of CV, CVC, and CVV. Moreover, he noted that the major divergences between the syllable structure of NA and that of CA can be summarised in three points. First, NA tolerates initial biconsonantal clusters, as in [**ħb**a:l]. In contrast, in CA, this word is realised as [ħi.ba:l], meaning that complex onsets are illicit in CA. Second, NA allows biconsonantal onset clusters in word-medial position preceded by the low long vowel /a:/, but only when the sequence of -CC- contains the two final radicals of the stem, such as [ka:.**tb**ah] 'having written (fem.)'. On the other hand, the sequence of internal -CC- is not tolerated in CA for two reasons. First, parsing the word [ka:.tbah] would have an illicit internal complex onset. Second, parsing the same word as [ka:t.bah] would have a non-final superheavy syllable, which is forbidden in CA. Thus, the previous example is realised in CA by inserting a vowel to split the initial consonant cluster in the second syllable, as in [ka:.t**i**.bah] in order to obviate either a complex onset or a non-final superheavy syllable. Third, the sequence of -CCC- only occurs in limited environments, where some verbal forms which have prefix and suffix added to the word base form, such as /ja-**ktb**-u:n/ 'they (mas.) are writing' and /ta-**ktb-**i:n/ 'you (fem. sg.) write'. This type of internal complex clusters is not allowed due to the ban of complex onsets in CA. In short, Ingham emphasised that NA allows complex onsets, but CA does not.

As stated earlier, each syllable structure has a specific distribution in a word. An overview of the syllable types will be introduced along with monosyllabic, disyllabic, and trisyllabic examples, based on their possible distribution, as shown in table (4) below: (cf. Abboud 1979, Ingham 1994, Alezetes 2007, Alqahtani 2014)[20].

[20] Those researchers have presented the syllable structure of central Najdi except Abboud. The Central Najdi Arabic have a common denominator of syllable structure inventories in NNA with slight differences. Abboud (1979) did not cover all the syllable patterns found in NNA.

Table 4: The Syllable Shapes with Examples in NNA

Syllable Pattern	Initial	Medial	Final	Weight
CV	[**ha**.la] 'welcome'	[jal.**ʕa**.bu:n] 'they (mas.) are playing'	[na.**da**] 'he called'	light
CCV	[**jti**.mag.rasˤ] 'uncomfortable'	[ʔin.**ksa**.rat] 'got broken'	----------	light
CVC	[**war**.dah] 'rose'	[mi.**sak**.tuh**]** 'I caught him'	[ʤir.**ʕah]** 'dose'	light/heavy
CVV	[**ha:**.ʤar] 'immigrated (mas. sg.)'	[jta:.**ha:**.jag] 'he stares at'	----------	heavy
CVG	[**dar**.**r**as] 'taught'	[mu.**ʕal**.**l**im**]** '**teacher'**	[**ham:**] 'worry'	heavy
CCVC	[**ʃʤir**.tuh] 'his (mas. sg.) tree'	----------	[ra:.**ħlah**] 'he went to her'	heavy
CCVV	[**mna:**.fis] 'competitor'	----------	----------	heavy
CVVC	[**ʕa:z**.muh] 'he invited him'	[mta.**ra:ħ**.mi:n] 'compassionate'	[jir.**ta:ħ**] 'he rests'	superheavy
CVCC	----------	----------	[li.**ʕibt**] 'I played'	superheavy
CCVVC	[**tra:f**.guh] 'she accompanies him'	----------	[**kba:r**] 'old (pl.)'	superheavy
CCVCC	----------		[ʔin.**tχibt**] 'I was elected'	superheavy
CVVG	[**fa:z.z**ah] 'thrilled (fem. sg.)'	[ʔal.**ʤa:d.d**ah] 'the road'	[**ħa:d:**] 'sharp (mas. sg.)'	superheavy

To sum up so far, the syllable structures of NNA are described based on their weight and position. To rephrase it, this dialect is composed of twelve syllable forms. These syllable structures are divided into three categories. First, two light syllables are CV and CCV. Second, five heavy syllables are CVC, CVV, CVG, CCVV, and CCVV. Third, five superheavy syllables are CVVC, CVCC, CCVVC, CCVCC, and CVVG. It should be noted that the heavy syllable CVG and the superheavy syllables CCVCC and CVVG are found in monosyllabic and multisyllabic words. On the contrary, the light syllables CV and CCV, the heavy syllables CVV, CCVC, and CCVV are only found in multisyllabic words. In NNA, onsetless syllables are proscribed since all syllables require either a single or a complex onset. Thus, the onset is compulsory, as found in CA. Codas can be single or complex, but it is not an obligatory constituent in NNA. That is, codas are optional because some syllable forms lack codas like the open syllable sequences CV, CVV, CCV, and CCVV, respectively. All in all, NNA have similar syllable sequences of that found in other Najdi Arabic varieties at large (Abboud 1979, Alqahtani 2014, AlMotairi 2015).

Despite the fact that NNA has almost the same number and distribution of syllable types found in some Najdi Arabic dialects: Riyadh and its surrounding cities, and Qassimi. I argue that there are some differences in the syllable structure representations. To elaborate these differences, the syllable shape CVVC in Central Najdi cannot be found in NNA in certain cases. This can be seen with a verb or a noun initially and medially, when it is attached to the possessive pronoun (a clitic) of the third person masculine plural -*ham* ‘them’, and to the possessive pronoun of the first person masculine plural -*na* ‘our’. This situation can be extended to a noun, or a verb attached to the object pronoun of the second person masculine singular -*ah*[21] ‘him’ in initial and/or medial word positions. Likewise, the same syllable shape in Central Najdi is treated differently in NNA, when it occurs initially with a noun attached to the possessive pronoun of the second person feminine singular -*ha*[22] ‘her’. In a similar vein, the syllable CVCC shape in Central Najd behaves differently in NNA. To explain, this syllable type is not possible in NNA with a noun attached either to the object pronoun of the third person masculine plural -*ham*, the possessive pronoun of the first person masculine plural -*na*, or the possessive pronoun of the second person feminine singular -*ha*. Consider the following examples in Central Najdi

[21] This object pronoun of 2nd person masculine singular is realised in NNA, such as -*uh* in [saː.ʕa.di.t-**uh]** ‘she assisted him’ rather than [saːʕ.di.t-**ah**].

[22] The feminine marker of the second person singular in CA and NA is -*ha* ‘her’ as in [wa.dˤij.fat-**haː**], [wi.ðˤij-fit-**ha**] ‘her job’, however, it is realised in NNA with the suffix -*ah*, such as in [wi.ðˤij.fi.t-**ah**] ‘her job’ (Van Putten 2017).

and Qassimi dialect, as shown in table (5), (Alqahtani 2014: 117, 152, Aljutaily and Alhoody 2020: 196- 197):

Table 5: The CVVC sequence shape in word-initial and medial positions

Word Position	**NA (Central Najdi &Qassimi Arabic)**	**NNA**
Initially	[**ʃa:f**.hum] ‘he saw them’	[ʃa:.**fa**.ham]
Medially	[mi.**ga:s**.hum] ‘their size’	[mi.ga:.**sa**.ham]
Initially	[**ʤa:b**.na] ‘he brought us’	[ʤa:.**ba**.na]
Initially	[**be:t**.ha] ‘her house’	[be:.**ta**h]
Medially	[sa:.**maħt**.hum][23] ‘I forgave them’	[sa:.maħ.**ta**.ham]

It can be noted from the previous examples that the realisation of the superheavy syllables CVVC and CVCC in NA including Qassimi Arabic are different in NNA. To this end, these syllable types undergo two phonological processes in NNA. First, the resyllabification process is met when the coda of the initial syllable in central Najdi becomes the onset of the second syllable in NNA. Also, this phonological process could be pertained to the concept of the onset maximisation principle. Second, vowel epenthesis is applied in the second syllable to affiliate a coda with a syllable node. Overall, I argue that it is difficult to generalise the syllable structure formations to all Najdi dialects without attesting each variety separately. More detail will be presented later in this chapter clarifying the syllabification patterns of heavy and superheavy syllables in the understudied dialect.

[23] According to Aljutaily and Alhoody (2020), superheavy CVVC and CVCC syllables are tolerated in Qassimi Arabic in both word-internal and word-final positions. In contrast, in Central Najdi, only a CVVC syllable is tolerated in word-internal and word-final positions, however, a CVCC syllable is confined only to word-final position (Alqahtani 2014).

NNA has words of up to six syllables. I already presented some monosyllabic, disyllabic, and trisyllabic words in (3.1) and (3.2), and in tables (3) and (4). Now, I will introduce quadrisyllabic, five, and six syllable words in NNA. Consider the following examples, as laid out in (3.3):

(3.3) Quadrisyllabic, five, and six syllable words in NNA

(1) Quadrisyllabic words

a. [mah.ra.ʤa:.na:t] ‘festivals’

b. [ʃa.ri.kat.kam] ‘your (mas. pl.) company’

c. [mas.ra.hij.jah] ‘play’

(2) five-syllable words

a. [jiχ.ta:.ru.na.ham] ‘they (mas.) select them’

b. [ʤaw.wa:.la:.ta.na] ‘our phones’

c. [ri.sa:.la:.ti.kin] ‘your (fem.) letters’

(3) Six-syllable words

a. [ti.ʤam.ma.ʕa:.ta.na] ‘our gathering’

b. [jta.ʕal.la.mu.na.hin] ‘they (mas.) learn them (fem.)’

c. [jta.na:.sˤi.fan.na.hin] ‘they (fem.) share it equally’

In conclusion, it can be assured that there is a common denominator for CA and NNA in terms of syllable inventories. To elucidate, both CA and NNA have light, heavy, and superheavy syllables. Onsetless syllables are disallowed in CA and NNA. This manifests that onsets are obligatory, and codas are optional constituents in a syllable, such as CV and CVV shapes in both CA and NNA. Moreover, they tolerate biconsonantal final coda clusters as found in CVCC. It should be borne in mind; however, there are some apparent differences between the syllable structure of CA and NNA. To clarify this point, NNA has wider syllable structure types compared to the ones found in CA: five syllable types in CA, and twelve syllable types in NNA. Initial biconsonantal clusters are legislated in NNA, whilst they are forbidden in CA.

Additionally, the distribution of the CVVC shape can only occur word-final position in CA, while in NNA, this type occurs in all word positions: initially, medially, and finally.

Having discussed the syllable structure shapes of CA and NNA, I now turn to the next section 3.4 to present an overview of syllabification, followed by the syllabification patterns in NNA. Also, I will address two main questions: how superheavy syllables are treated word-internally and word-finally, and what are the adopted phonological processes/rules in order to motivate the ban on trimoraic syllables in NNA.

3.4 An Overview of Syllabification

Syllabification is defined as a phonological phenomenon whereby words or phrases are divided into syllables, either in speech or writing. The syllable weight plays a vital role in the typology of syllabification patterns. Some syllable structure forms provide a straightforward and less problematic illustration with respect to the maximal syllabic weight in Arabic (bimoraicity) under Moraic Theory. For illustration, superheavy CVVC, CVCC, and CVVG syllables are prosodically trimoraic syllables. Thus, these syllables should be resolved in order to comply with the maximal weight limit per content words in the investigated dialect. Hayes (1989, 1995), Broselow (1992), Kenstowicz (1994), Kiparsky (2003), and Watson (2007) provided various approaches to treat final and non-final superheavy syllables of the forms CVVC, CVCC, and CVVG to motivate the ban on trimoraic syllables in the language in question.

In NNA, as in most Arabic dialectal variations, the minimal syllable is monomoraic and the maximal syllable is bimoraic. CVV and CVC syllables are prosodically heavy and considered bimoraic. However, this is not always the case with a CVC syllable because the Weight-By-Position (WBP) principle (Hayes 1989) is active in the grammar of NNA. To demonstrate this point, in domain-internal position, a CVC syllable is prosodically heavy, since the coda consonant is assigned mora, whereas in domain-final position, a CVC syllable is considered light (monomoraic), wherein the final consonant is licensed as extrametrical (non-moraic or weightless). Hung (1994) confirmed that in most Arabic varieties, CVC syllables are heavy word-internally but not at the end of the word. For instance, in NNA, the initial syllable of the shape CVC in the word [**far**.ħa.nah] 'she is happy' is deemed heavy (bimoraic), since it occurs word-internally under the pressure of the constraint WBP. However, the same syllable type is considered light (monomoraic) when it occurs word-finally, as in [jal.**ʕab**] 'he plays', since the last consonant of the final syllable /b/ is treated as extrametrical. It should be mentioned here that simplex and complex onsets are not dominated by a mora because they do not contribute weight to the syllable (weightless).

Cross-linguistically, the representation of superheavy syllables, CVVC, CVCC, and CVVG is the main issue in phonological theory. These syllable forms behave differently with respect to their distribution (unrestricted vs. word-finally) and weight (heavy vs. superheavy). The question arises here as to why the analysis of CVVC, CVCC, and CVVG syllables has caused an issue in non-final positions. As mentioned earlier, the maximal syllable weight in Arabic must be bimoraic. However, the final coda of CVVC and CVCC syllables adds a mora only word-internally (recall the WBP condition in 2.14). In this case, these syllables are prosodically deemed as trimoraic. Generally, most Arabic dialects permit CVVC, CVCC, and CVVG syllables only in word-final domain and trimoraic syllables are avoided in non-final position by applying certain repair strategies or phonological rules to retain the general preference for bimoraicity. More precisely, parsing the final segment in such syllables is analysed differently across languages both word-internally and word-finally to avoid trimoraicity.

Before embarking on the discussion of heavy and superheavy syllables in NNA, let us see briefly how some Arabic vernaculars account for superheavy CVVC and CVCC syllables in word-internal position.

3.4.1 CVVC and CVCC Syllables in Some Arabic Dialects

CVVC and CVCC syllables exist only in word-final position in a wide range of modern Arabic varieties. However, these varieties employ diverse strategies for obviating non-final CVVC and CVCC syllables to appear in a number of consonant-initial suffixes. For instance, vowel epenthesis is implemented in Makkan Arabic between the stem-final CVVC and a following consonant within the same word. Consider the following data from Makkan Arabic in (3.4) below:

(3.4) Vowel Epenthesis in Makkan Arabic (Abu-Mansour 1992: 138)

(1) /kita:b/	[ki.ta:b]	‘book’
a. /kita:b-i/	[ki.ta:.bi]	‘my book’
b. /kita:b-na/	[ki.ta:.b**a**.na]	‘our book’
c. /kita:b-kum/	[ki.ta:.b**a**.kum]	‘your (pl.) book’

It should be noted that CVVC syllables are avoided in a word-internal position by moving the stem-final consonant to the onset position and inserting a vowel in order to avoid trimoraic syllables: the strategy of vowel epenthesis invents a new syllable to affiliate the onset /b/ with a syllable.

Another repair strategy has been invoked for obviating non-final CVVC syllables, namely, vowel shortening in a closed syllable. Consider the following data of Cairene Arabic and the central western varieties of the Nile Delta Arabic, as laid out in (3.5):

(3.5) Vowel Shortening in Cairene Arabic (Broselow 1992: 49, Watson 2002: 66-69)

(1) /ki.ta:b/	[ki.ta:b]	‘book’
a. /kita:b-na/	[ki.t**a**b.na]	‘our book’
b. /ba:b-kum/	[b**a**b.kum]	‘your pl. door’
(2) /ra:ħ/	[ra:ħ]	‘he went’
a. /ra:ħ-la-ha/	[r**a**ħ.la.ha]	‘he went to her’

The data in (3.5) shows that Cairene Arabic employs the vowel shortening process where the long vowel /a:/ shortens before any two consonants. This phonological process is utilised as a remedy strategy for the sake of avoiding trimoraicity syllables. Thus, the presupposition that trimoraic syllables are avoided is compatible with the restricted occurrence of CVVC syllables in word-final only, as found in Cairene Arabic (Broselow 2017).

In contrast, some varieties of Arabic allow CVVC syllables in a word-internal position after suffixation (Broselow 1992, Broselow *et al.* 1995, Farwaneh 1995). For instance, Sudanese, Levantine, and the Gulf Arabic dialects permit non-final CVVC syllables, such as in the word /ba:b-na/ 'our door' → [**ba:b**.na], and in San'ani Arabic, such as in the word /kita:b-na/ 'our book' → [ki.**ta:b**.na]. In general, we can differentiate between dialects that tolerate CVVC syllables and those that do not in a word-internal position by the allowance of trimoraic syllables. However, cross-linguistically, many studies have reported that there is agreement on an outright prohibition against trimoraic syllables, which can be extended to dialects that tolerate non-final superheavy syllables (Broselow 2017: 38). Thus, these dialects consider non-final CVVC syllables as bimoraic because the final coda consonant is analysed differently, which in turn does not add weight to such syllables, i.e., the last consonant is deemed as a degenerate syllable or a stray consonant.

Different approaches are implemented to represent CVVC syllables word-medially as bimoraic. Kiparsky (2003) analysed CVVC syllables as containing a core CVV syllable followed by a semisyllable: a consonant with a catalectic mora that links directly to the prosodic word node. This means that the last consonant of a CVVC syllable is moraic but unaffiliated with a syllable node (in violation of SLH). According to Kiparsky's analysis, the tolerance of semisyllables[24] is therefore consistent with the tolerance of CVVC syllables in a word-internal position. Another approach is called 'mora sharing', which analyses CVVC as consisting of a single syllable but deprives the coda from assigning weight to the syllable and allowing it to share a mora with the preceding vocalic segment (Broselow 1992, Broselow *et al.* 1995, Watson 2007). Mora sharing analysis is adopted only with non-final CVVC syllables in dialects that forbid inserting a vowel after the final consonant of CVVC, as in Makkan Arabic, creating a new syllable. Furthermore, this repair strategy is inapplicable when employing a vowel shortening strategy in order to eliminate one of the vocalic moras, as found in Cairene Arabic.

Regarding a CVCC sequence, most modern Arabic dialects forbid this type of syllable from appearing word-internally. Thus, the final consonant becomes non-peripheral via morpheme concatenation. The avoidance of such syllables can be ascribed to various phonological

[24] The notion of semisyllables has been adopted to account for stress assignment opacity (Kiparsky 2003). For instance, the Arabic word [ka.ˈta.bit] 'I wrote', where the light penultimate syllable attracts stress rather than the antepenultimate one. Kiparsky asserted that stress applies at the lexical level, as in /katab-t/ where the final consonant -*t* is treated as a semisyllable [ka.ˈtab<t>]. Accordingly, the stress assignment is transparent because stress falls on the heavy ultimate syllable. After suffixation, semisyllables are not affiliated to syllable nodes. However, in order to parse a semisyllable consonant with a syllable, vowel epenthesis process is employed to remedy the ill-formed final consonant cluster /bt/ surfacing as [ka.ˈta.bit].

processes that are implemented as repair strategies. Cairene, Makkan, and Iraqi Arabic resort to vowel epenthesis as a remedy strategy to avoid the realisation of medial non-final CVCC syllables. Consider the following data in (3.6) that exemplify the treatment of CVCC syllables in Cairene, Makkan, and Iraqi Arabic:

(3.6) Vowel Epenthesis (Broselow 1992: 11-12, 20-21)

1. Cairene Arabic

a. /kalb/	[kalb]	‘dog’
/kalb-na/	[kal.b**i**.na]	‘our dog’
b. /ka.tabt/	[ka.tabt]	‘I wrote’
/katabt-l-u/	[ka.tab.t**i**.lu]	‘I wrote to him’

2. Iraqi Arabic (similarly Syrian, Levantine, Palestinian)

a. /bint/	[bi.n**i**t]	‘girl’
/bint-na/	[bi.n**i**t.na]	‘our girl’
b. /katab-t/	[ki.ta.b**i**t]	‘I wrote’
/katab-t-l-a/	[ki.ta.b**i**t.la]	‘I wrote to her’

3. Makkan Arabic

a. /bint/	[bint]	‘girl’
/bint-na/	[bin.t**i**.na]	‘our daughter’
b. /katab-t/	[ka.tabt]	‘I wrote’
/katab-t-h-a/	[ka.tab.t**a**.ha]	‘I wrote to it (fem.)’

As can be revealed from the data in (3.6), in Cairene Arabic, CVCC syllables undergo the resyllabification process after suffixation. That is, the coda of the initial syllable moves to the onset of the following syllable, and the vowel is inserted to a newly-created syllable to avoid superheavy syllables in word-internal position; for example, /kalb-na/ 'our dog' syllabifies as [kal.bi.na]. In Iraqi Arabic, the vowel epenthesis strategy is applied after the first member of the coda cluster to prevent superheavy syllables to occur word-medially. This process limits the syllable weight from trimoraic to bimoraic; for example, /katab-t/ 'I wrote' is realised as [ka.ta.bit]. Similar phonological processes are adopted in Makkan Arabic, where the CVCC syllables are resyllabified and avoided by inserting a vowel to retain the bimoraicity. For example, the word /bint-na/ 'our daughter' is resyllabified so that the coda /t/ becomes the onset of the following syllable and the vowel /i/ is epenthesised to affiliate a semisyllable or a stray consonant with a syllable node yielding [bin.t**a**.na]. In terms of analysing the final consonant of CVCC sequences, Broselow (1992) stated that the stem-final consonant /b/ is treated as extrametrical and not visible for syllabification, as in [ki.ta⟨b⟩] 'he wrote'. However, after suffixation, as in [ki.tabt] 'I wrote', the unsyllabified consonant /b/ forfeits its extrametrical status and integrates into the following syllable. The final consonant ⟨t⟩ remains extrametrical after suffixation (recall the extrametricality rule in Chapter Two, 2.6.1).

To sum up so far, According to Broselow (1992), CVVC syllables are tolerated in stem-final position in all Arabic varieties, and in medial position in some. However, CVCC syllables are tolerated stem-finally in some Arabic varieties but medially in none. Also, all modern Arabic dialects adhere to the essential constraint on syllable structure, 'the Bimoraicity Constraint', in which it operates to the possible syllable structures to change the syllable structure through the derivation.

3.4.2 Syllabification Patterns in NNA

In this study, I consider the phonological word as the primary domain of syllabification. The phonological word involves the word stem plus any affixes. For instance, /ktub-ah/ 'he wrote it' constitutes the word stem [ktub] and the attached suffix -ah. To the best of my knowledge, no previous studies of syllabification have tackled the analysis of superheavy syllables in word-final and non-final positions under the moraic approach in NNA. As can be noted from the syllable types presented in 3.3.2, CVC syllables are tolerated in all word positions in which they are monomoraic word-finally, but they are bimoraic in a non-final word position due to the effect of the WBP constraint. Superheavy CVVC syllables are permitted in both word-final and non-final positions, but superheavy CVCC syllables are confined to occur only word-finally in the dialect. Superheavy CVVG syllables are tolerated in word-final and non-final positions.

I hypothesise in this thesis that trimoraic syllables are proscribed in NNA. Accordingly, it is assumed that CVVC and CVCC syllables are underlyingly bimoraic in the dialect because these syllables are composed of a bimoraic syllable followed by a stray consonant. These stray consonants are treated differently in a way that do not bear weight to a syllable to maintain the bimoraicity status in the dialect. To clarify, in domain-final position, extrasyllabicity (Itô 1986, Hayes 1982, 1989, 1995) is invoked to account for both CVVC and CVCC syllables. This approach is utilised because it is confined to the word-final position, and it meets the Peripherality Condition. In domain-internal position, mora sharing or the Adjunction-to-Mora Principle (Broselow 1992, Watson 2007) is invoked to account for CVVC syllables in NNA. This approach is utilised because it affiliates the final consonant with a syllable node and satisfies the Strict Layering Hypothesis (SLH). With regard to geminate consonants, CVG and CVVG syllables are treated differently in NNA. Recall Hayes' (1989) proposal for moraic representation; he differentiated between geminate consonants and singleton coda consonants in which geminates are underlyingly associated to moras and non-geminate consonants are underlyingly non-moraic. The proposal of non-moraic segments can be generalised to the rightmost part of a geminate that links to the onset of the following syllable. That is, CVG syllables are underlyingly bimoraic since a vocalic segment and a geminate consonant are weight-bearing units (see the geminate representation under moraic theory in 2.17). CVVG syllables word-internally are prosodically trimoraic since the long vowels are bimoraic followed by a geminate (monomoraic). On this account, the analysis of CVVG syllables is apparently problematic because it violates the bimoraicity constraint that requires the weight of per syllable to be maximally bimoraic. Rather, following Broselow *et al*. (1997) and Watson (2007), it is assumed in this study that adopting the mora-sharing account, where the leftmost part of a geminate shares a mora with the preceding rightmost vowel (recall 2.32 and 2.33 regarding the Mora-Sharing Principle), is deemed a solution to reduce the syllable from being trimoraic to bimoraic (cf. Watson 2002, Khattab and Al-Tamimi 2014 for a similar proposal).

To recap, superheavy CVVC, CVCC, and CVVG syllables are allowed in a word-final position and the last segments are considered as extrasyllabic to avoid trimoraicity. In a word-internal position, a CVVC syllable is permitted in the dialect in which the mora sharing rule is adopted in order to avoid trimoraic syllables. It should be highlighted here that a geminate in a CVVG syllable never occurs in tautosyllabic words. Thus, the first part of a geminate occupies the coda of the initial syllable, and the second part of a geminate occupies the onset of the following syllable and is considered non-moraic because all onsets are weightless in the dialect. Therefore, mora sharing is best to account for both CVVG and CVVC syllables to avoid trimoraic syllables because the final segment occurs word-internally and is preceded by a vowel, which is underlyingly moraic.

In the upcoming subsections, I will dwell on the potential analysis of final and non-final heavy and superheavy syllables to tackle the matter of parsing final consonants/geminates, where possible. I will also discuss the treatment of such syllables to avoid trimoraicity in the dialect under Moraic Theory.

3.4.2.1 CVC Syllables

The distribution of a CVC syllable is unrestricted and can be found in word-internal and word-final positions. The weight of a CVC syllable is context-dependent and determined by its position in a given word. In NNA, following the WBP rule, the implication is that CVC syllables are heavy in non-final position, whilst they are light in a word-final position. The stress assignment[25] has also been used as compelling evidence for the distinctive weight of CVC syllables. That is, the penultimate syllable attracts stress in words of the syllable shape **CV**.CV, but also in the syllable shapes of **CV**.CVC and CV.**CVC**.CVC. Therefore, the CVC syllable in the canonical form CV.**CVC** fails to assign stress word-finally because it is regarded as light, while in CV.**CVC**.CVC, the penultimate syllable attracts stress because it is regarded heavy and occurs in a word-internal position (Watson 1999). Fundamentally, CV and CVC are treated similarly in a word-final position with respect to stress assignment because they are monomoraic. Consequently, based on the stress system and the WBP condition, CVC is interpreted as a bimoraic syllable word-internally[26] and a monomoraic syllable word-finally under Moraic Theory. However, CV syllables are permanently monomoraic in all word positions. Consider the following examples in (3.7):

[25] The stress assignment and foot construction will be covered in the last chapter.
[26] Under moraic theory, it is worth noting that CVV and internal CVC syllables are equal in their weight in NNA since they are both heavy (bimoraic).

(3.7) CVC syllables word-finally and word-internally/CV word-finally

a. [ˈʤa.**las**] ‘he sat’

b. [ʤa.ˈ**las**.na] ‘we sat’

c. [ta.ˈrak.**na**] ‘he left us’

These examples show that the final consonant in CVC syllables behaves differently in NNA. In (a), the CVC syllable in the word-final position fails to attract stress since the final consonant does not add weight to the syllable and hence it is treated as extrametrical ⟨s⟩ (Hayes 1989, 1995). On the other hand, in (b), the CVC sequence in the word-internal position is deemed heavy since it attracts stress because the final consonant adds weight to the syllable (moraic). In (c), the example shows that the CV syllable in the word final position behaves in the same way as a CVC syllable does in a word final position since they are both considered monomoraic. All in all, following Hayes (1982, 1989, 1995), I assume that the final consonant at the right edge of words is treated as extrametrical and fails to assign a mora because it is not eligible for the weight enforcement constraint Weight-By-Position. Let us now scrutinize how final and non-final heavy and superheavy CVVC, CVCC, CVG, and CVVG sequences behave with regard to the syllabic weight in the understudied language.

3.4.2.2 Final Superheavy CVXC and CVVG Syllables

In NNA, as in most Arabic varieties, superheavy syllables are tolerated to surface faithfully in a word-final position at the lexical level and sometimes after derived environments. Consider the following data in (1) and (2) below exemplifying words that contain CVVC, CVCC, and CVVG sequences in a word-final position:

1. Final CVVC Syllables

Underlying form	**Surface form**	**Gloss**
a. /ʤa:b/	[**ʤa:b**]	he brought
b. /tˤa:r/	[**tˤa:r**]	he flew
c. /ʤa:r/	[**ʤa:r**]	neighbor
d. /maʃ.ɣo:l/	[maʃ.**ɣo:l**]	busy/occupied
e. /bi.ba:n/	[bi.**ba:n**]	doors

2. Final CVCC Syllables

a. /ʔams/	[**ʔams**]	yesterday
b. /dars/	[**dars**]	lesson
c. /nafs/	[**nafs**]	soul
d. /ʤalas-t/	[ʤa.**last**]	I sat down
e. /niʤaħ-t/	[ni.**ʤaħt**]	I succeed

3. Final CVVG Syllables

a. /ʤa:d:/	[**ʤa:d:**]	serious (mas. sg.)
b. /ħa:d:/	[**ħa:d:**]	sharp (mas. sg.)
c. /ʕa:m:/	[**ʕa:m:**]	general
d. /ðˤa:r:/	[**ðˤa:r:**]	harmful (mas. sg.)

It can be observed from (1) that NNA permits superheavy CVVC syllables in a word-final position with no restrictions. In (2), superheavy CVCC syllables are permitted in a word-final position, but the occurrence of some coda clusters is sensitive to the Sonority Sequencing Sonority (SSP)[27]. The coda of superheavy CVVC and CVCC syllables word-finally are analysed differently based on diverse interpretations to avoid trimoraic syllables, i.e., the final consonant of superheavy syllables should not contribute weight to a syllable. In (3), final CVVG syllables are tolerated in the dialect, but they are confined to monosyllabic words. Following Hayes (1995) and Kager (1995), this study assumes that superheavy CVVC, CVCC, and CVVG syllables are bimoraic in a word-final position because the final segments are regarded as

[27] The relation between the SSP and consonant clusters will be discussed intensively in Chapter Four.

extrasyllabic, i.e., fall outside the syllable domain. In this work, extrasyllabicity is limited to the coda and the geminate consonant of CVVC, CVCC, CVVG syllables in a word-final position since it satisfies the peripherality condition (Hayes 1995). As a result, the bimoraicity condition represents the maximum limit weight per syllable that is highly respected in the dialect.

3.4.2.3 Internal CVG and CVVG Syllables

As mentioned previously in Chapter Two, the moraic view of geminate consonants is assumed to be weight-bearing units, which are underlyingly dominated by one mora based on Moraic Theory (Hayes 1989). In Arabic, the same view has always been adopted where the stress mechanism supports this view within Moraic Theory. This is also motivated by the fact that CVG syllables can attract stress word-internally, which assures that a geminate is inherently moraic. Therefore, a CVC and a CVG syllable behave in a similar way prosodically in a word-internal position since they are bimoraic.

In many Arabic varieties, non-final CVG syllables are attested, and it is discovered that they are subject to degemination after suffixation. For example, in Levantine Arabic, the word /ʔim:-na/ ‘our mother’ surfaces as [ʔim.na] (Farwaneh 2009: 96). In NNA, however, no degemination is reported with an internal CVG syllable after suffixation and the same example presented in Levantine Arabic /ʔimm-na/ is realised as [ʔum.ma.na] but not *[ʔumm.na] in NNA. However, this does not hold any ground for a final CVG syllable in derived environments in the dialect. That is to say, the avoidance of CVG word-finally in disyllabic words is achieved by the phonological phenomenon of degemination when a verb is concatenated with prefixes like the definite article ʔal-, ji-, or ti-. For example, the final geminates in /ji-ʃid:/ ‘he pulls’, /ti-mid:/ ‘she spreads’, and /ʔal-ʕam:/ ‘uncle’ undergo degemination [ji.ʃid], [ti.mid], and [ʔal.ʕam] (cf. Prochazka 1988: 21). This phonological behaviour triggers stress shift in which stress shifts from ultimate in the stem level to penultimate in the word level via degemination, such as [ˈʃid:] ‘pull’, which is realised as [ˈji.ʃid] after prefixation.

As for a non-final CVVG syllable, Arabic and its varieties eschew CVVG syllables in multisyllabic words through certain repair strategies, e.g., vowel shortening or onset maximisation. In Southwestern Saudi Arabic dialect, a long vowel is shortened before a geminate, or a geminate serves as the onset of the following syllable for a potential CVVG syllable through onset maximisation. For instance, the long vowel is shortened as in the underlying form /ga:l-l-na/ 'he said to us', which surfaces as [g**a**l.la.na]. Another example within the same dialect is seen where the geminate moves to the onset position of the following syllable as in /ħa:d:-a/ 'sharp (fem. sg.)', which surfaces as [ħa:.**d:**a] (Alahmari 2018: 100). This study argues that NNA treats CVVG syllables in a word-internal position differently compared to Classical Arabic and many of its varieties when avoiding trimoraic syllables. It can be generalised that the surface form of a geminate is quite restricted to heterosyllabic context but never tautosyllabic[28] with multisyllabic words after suffixation in both CVG and CVVG syllables in the language. Consider the following examples shown in (1) and (2), which exemplify a non-final CVG and CVVG syllable in NNA, respectively:

1. Non-Final CVG Syllables

Underlying form	**Surface form**	**Avoided form**	**Gloss**
a. /ʔum:-ah/	[ʔum.mah]	*[ʔu.m:ah]	her mother
b. /ʔum:-kam/	[ʔum.ma.kam]	*[ʔum:.kam]	your (mas. pl.) mother
c. /ʕam:-uh/	[ʕam.muh]	*[ʕa.m:uh]	his uncle
d. /χad:-ah/	[χad.dah]	*[χa.d:ah]	her cheek
e. /mad:-l-ah/	[mad.d**a**.lah]	*[mad:.lah]	he handed to her

As can be readily seen in (1), no degemination or any other phonological processes have been applied when producing geminates with vowel-initial suffix words. The surface heterosyllabic geminates are monomoraic and syllabify as the coda of the initial syllable and the onset of the following syllable in the language. Thus, all CVG syllables obey the permissible weight limit per syllable in NNA, which is bimoraic. For example, the underlying form /ʕam:-uh/ 'his uncle' is realised as [ʕam.muh] in the dialect, where the single vowel /a/ preceded the geminate assigns one mora, and the left leg of the geminate (the coda of the initial syllable) assigns one mora. However, the right leg of the geminate (the onset of the second syllable) is moraless

[28] Alhuwaykim (2018: 93) reported that CVG syllables word-internally occur in tautosyllabic in Northwestern Saudi Arabian Arabic dialect, such as the word /ʕamm-kum/ 'your (mas. pl.) uncle' surfaces as [ʕamm.kum]. Alqahtani (2014: 141-142) posited that CVG syllables can occur in both environments in Central Najdi Arabic: tautosyllabic and heterosyllabic in a non-final position. For instance, the word /ham:-ha/ 'her concern' surfaces as [ham:.ha] and the word /ham:-ah/ 'his concern' surfaces as [ham.mah].

(weightless) because onsets are always moreless in NNA. In consonant-initial suffix words, it should be noted that vowel epenthesis is applied after the right leg of the geminates in order to avoid -CCC- sequences in a word-internal position, but this will not affect the ban on trimoraicity syllables. For example, the word /ʔum:-kam/ 'your (mas. pl.) mother' is realised as [ʔum.m**a**.kam], where the low vowel /a/ is epenthesised after the second member of the geminate to preclude internal triconsonantal clusters.

2. Non-Final CVVG Syllables

Underlying form	**Surface form**	**Avoided form**	**Gloss**
a. /ʃa:b:-ah/	[ʃa:b.bah]	*[ʃa:.b:ah]	young woman
b. /ʤa:d:-ah/	[ʤa:d.dah]	*[ʤa:.d:ah]	serious (fem.)
c. /ha:m:-ah/	[ha:m.mah]	*[ha:.m:ah]	important (fem.)
d. /ʕaam:-k/	[ʕa:m.m**a**k]	*[ʕaam:k]	your (mas. sg.) general
e. /ʕaam:-kam/	[ʕa:m.m**a**.kam]	*[ʕaam:.kam]	your (mas. pl.) general

In (2), it can be observed from the data that all forms surface faithfully with no repair strategies in NNA, like vowel shortening or degemination in order to motivate the ban on trimoraic syllables. Bear in mind that a short vowel is monomoraic, a long vowel is bimoraic, a singleton consonant is moraless if it appears word-finally, and a geminate is monomoraic (Hayes 1989). In NNA, geminate consonants of the form CVVG are syllabified as a coda of the initial syllable and an onset of the following syllable. In most languages, including Arabic, onsets do not contribute weight to the syllable. Therefore, CVVG syllables are underlyingly trimoraic. To cope with this problem, the mora-sharing rule is invoked to preserve the bimoraicity status. That is to say, the leftmost part of the geminate shares a mora with the preceding vocalic mora in order to maintain the bimoraic structure of the syllable. For instance, the underlying form /ʤa:d:-ah/ 'serious (fem.)' surfaces as [ʤa:**d**.**d**ah] in NNA, where the left leg of the geminate shares the rightmost mora with the preceding vowel without adding weight to the syllable to evade trimoraicity (Broselow *et al.* 1997, Watson 2007, Khattab and Al-Tamimi 2014). Furthermore, vowel epenthesis is applied when a CVVG syllable is concatenated with consonant-initial suffixes in order to avoid medial triconsonantal clusters, such as with /ʕa:m:-k/ 'your (mas. sg.) general', which generally surfaces as [ʕa:m.m**a**k].

3.4.2.4 Internal Superheavy CVVC Syllables

Unlike many Arabic varieties, superheavy CVVC syllables are canonical and tolerated to surface faithfully in a word-internal position. Some possible medial CVVC syllables can arise as a result of a morphological concatenation of both single and multiple suffixes. In CVVC syllables after suffixation, a suffix can be seen as a consonant-initial suffix and/or a vowel-initial suffix. A set of data will be introduced exemplifying non-final CVVC syllables, as is shown in (1) below:

1. Non-Final CVVC Syllables

Underlying form	**Surface form**	**Avoided form**	**Gloss**
a. /tˤa:l**i**b-ah/	[**tˤa:l**.bah]	*[tˤa:.lbah]/*[tˤa:.la.bah]	female student
b. /na:ʤ**i**ħ-ah/	[**na:ʤ**.ħah]	*[na:.ʤħah]/*[na:.ʤa. ħah]	she succeeded
c. /mitfa:h**i**m-i:n/	[mit.**fa:h**.mi:n]	*[mit.fa:.hmi:n]/ *[mit.fa:.hi.mi:n]	they understand each other
d. /ka:t**i**b-ah/	[**ka:t**.bah]	*[ka:.tbah]/*[ka:.ta.bah]	female writer

It can be observed from (1) that some CVVC sequences are tolerated word-internally in NNA. Likewise, we have seen from the previous examples that internal CVVC syllables can emerge from the concatenation of single and/or multiple suffixes. In illustrating the examples in (1), it can be noted from the data that the high vowel deletion causes the creation of non-final CVVC syllables when the stem is morphologically concatenated. An example is found in the output [**tˤa:l**.bah] ‘female student’, wherein the /l/ is resyllabified into the coda of the initial syllable and the high vowel is deleted in order to allow non-final superheavy CVVC syllables to surface. This surface form is different from other Arabic varieties, as the previous example surfaces differently in Cairene Arabic as [tˤa:.li.bah] or [tˤal.bah] as a result of vowel epenthesis or vowel shortening, respectively. Also, a more recent study by Alahmari (2018: 98), he pointed out that an internal CVVC syllable is avoided through an onset maximisation process, as in /fa:him-a/ ‘understanding (fem.)’, which surfaces as [fa:.hma] in Southern Saudi Arabian dialect. In (c) and (d), high vowel syncope is invoked to create medial superheavy CVCC syllables in the language. For instance, the input /ka:t**i**b-ah/ ‘female writer’ surfaces as [**ka:t**.bah], wherein the low vowel /i/ is syncopated to allow internal CVVC to surface.

Now, the central issue is how we treat the final consonant (i.e., the stray consonant) of internal superheavy CVVC syllables to avoid trimoraic syllables. These syllables are composed of heavy syllables plus semisyllables (Kiparsky 2003). Semisyllables are moraic consonants but directly linked to the prosodic word, i.e., they are unaffiliated with the syllable node. This analysis is problematic because it would violate the Strict Layering Hypothesis (SLH) and the constraint LICENSE-μ, as the final consonant in a CVVC syllable word-internally is not affiliated with a syllable. Accordingly, to account for CVVC syllables word-internally, I will follow Broselow (1992) and Watson (2007), who proposed the notion of mora sharing or adjunction-to-mora. This notion is implemented to analyse the final consonant in internal CVVC sequences for the sake of satisfying the bimoraicity constraint and affiliating a coda to a syllable node. This analysis can be achieved when a coda shares a mora with the preceding vowel. Further, applying this approach would satisfy the SLH and LICENSE-μ. All in all, bimoraicity is maintained in non-final superheavy CVVC syllables in NNA.

To sum up so far, we have established the syllabification patterns of heavy and superheavy syllables in word-final and word-internal positions. Also, we have identified the parsing of the final consonant in CVVC syllable forms under moraic theory to maintain the maximum limit of syllabic weight which is bimoraic. Now, we turn to the question of does NNA always avoid some internal superheavy syllables and how. To answer this question, the next subsection 3.4.2.5 will devote to demonstrating the treatment of such syllables to avoid trimoraic syllables in the language.

3.4.2.5 The Avoidance of Internal Superheavy CVXC Syllables

As presented earlier, internal superheavy CVCC syllables are illicit in the language and thus some repair strategies are utilised instead to avoid trimoraicity. However, although internal CVVC syllables are tolerated in NNA, some words become vulnerable to containing internal superheavy CVVC syllables after suffixation in NNA. Thus, mora sharing and extrasyllabicity (i.e., the last consonant of CVV**C** sequences) are blocked through certain repair strategies. Two sets of data will be introduced manifesting how potential non-final superheavy CVVC and CVCC syllables are avoided, as shown in (1) and (2). We should observe from these examples that all the stem words are concatenated with either a consonant-initial suffix or a vowel-initial suffix. Some forms of CVVC syllables are not tolerated word-internally in derived environments through two repair strategies in order to avoid trimoraic syllables: vowel epenthesis and/or onset maximisation. Similar repair strategies have been observed with all internal superheavy CVCC syllables in order to avoid trimoraicity. Vowel epenthesis is a very prevalent repair strategy for avoiding trimoraicity to occur word-internally in a range number of modern Arabic dialects. This strategy often emerges when a superheavy syllable is concatenated with a consonant-initial suffix. On the contrary, onset maximisation is rarely used to avoid internal trimoraic syllables in contemporary Arabic dialects (cf. Alahmari 2018). This strategy usually occurs when a superheavy syllable is followed by a vowel-initial suffix. The choice of these repair strategies is not arbitrary in NNA, but it follows a systematic method due to certain morphological environments. Consider the data in (1) and (2) below:

1. The Treatment of Some Internal CVVC Syllables

Underlying form	**Surface form**	**Avoided form**	**Gloss**
a. /be:t-na/	[be:.t**a**.na]	*[be:t.na]	our house
b. /mustaʃa:r-ham/	[mus.ta.ʃa:.r**a**.ham]	*[mus.ta.ʃa:r.ham]	their consultant
c. /ʃa:f-ham/	[ʃa:.f**a**.ham]	*[ʃa:f.ham]	he saw them (mas.)
d. /ba:b-na/	[ba:.b**a**.na]	*[ba:b.na]	our door
e. /ʤa:r-kam/	[ʤa:.r**a**.kam]	*[ʤa:r.kam]	your neighbour
f. /ʤa:b-ham/	[ʤa:.b**a**.ham]	* [ʤa:b.ham]	he brought them
g. /ʤa:b-l-ham/	[ʤa:.**bla**.ham]	*[ʤa:b.la.ham]	he brought to them
h. /ra:ħ-l-kam/	[ra:.**ħla**.kam]	*[ra:ħ.la.kam]	he went to you (pl.)
i. /ra:ħ-l-ah/	[ra:.**ħl**ah]	*[ra:ħ.lah]	he went to her

2. The Treatment of Internal CVCC Syllables

Underlying form	**Surface form**	**Avoided form**	**Gloss**
a. /gil-t-l-uh/	[gil.**tl**uh]	*[gilt.luh]	I said to him
b. /bint-na/	[bin.t**i**.na]	*[bint.na]	our daughter
c. /kalb-ham/	[kal.b**a**.na]	*[kalb.na]	our dog
d. /ʕarif-t-ham/	[ʕa.rif.t**a**.ham]	*[ʕa.rift.ham]	I knew them
e. /kitab-t-l-ah/	[ki.tab.**tl**ah]	*[ki.tabt.lah]	I wrote to her
f. /kitab-t-l-ham/	[ki.tab.**tla**.ham]	*[ki.tabt.la.ham]	I wrote to them
g. /risam-t-l-kam/	[ri.sam.**tla**.kam]	*[ri.samt.li.kam]	I drew to you (pl.)

In (1), all the examples show that a potential internal superheavy CVVC syllable is avoided through vowel epenthesis and/or onset maximisation. To be more specific, vowel epenthesis is utilised as a repair strategy when a CVVC syllable (a stem) is concatenated with only single consonant-initial suffix. For example, the word /be:t-na/ ‘our house’ surfaces as [be:.t**i**.na], wherein the coda of a CVVC syllable is being resyllabified as the onset of the following syllable and a vowel is inserted to affiliate the singleton onset with a syllable node. Therefore, the superheavy CVVC syllable in a non-final position is avoided in the language through vowel epenthesis to adhere to the bimoraicity restriction per syllabic weight. On the other hand, the presence of an onset maximisation process is confined to the presence of the dative suffix /l/ after the derivation level in all examples. This process is utilised as a repair strategy when a CVVC syllable is concatenated with a vowel-initial suffix and preceded by the dative suffix /l/ to avoid trimoraicity. For instance, /ra:ħ-l-ah/ ‘he went to her’ is realised as [ra:.**ħl**ah], where the coda of the stem CVVC syllable is resyllabified into an onset of the following syllable in which it becomes the first member of the complex onset and the second one is the dative suffix /l/. On the other hand, onset maximisation cannot stand alone with some forms, and it should be adopted along with vowel epenthesis to avoid trimoraic syllables. These repair strategies are integrated only when a CVVC syllable is concatenated with more than one consonant-initial suffix; usually the second suffix is the dative /l/. For instance, /ʤa:b-l-ham/ ‘he brought to them’ is realised as [ʤa:.**bla**.ham], where the coda of the stem CVVC syllable is resyllabified into an onset of the following syllable joining the dative suffix /l/ to form complex onset and a vowel epenthesis process is applied in order to affiliate the complex onset with the syllable and to avoid initial CCC syllables.

After presenting the permissible internal CVVC syllables in subsection (3.4.2.4) and how some of them are avoided in (3.4.2.5), a question that arises in this context is why mora-sharing was employed to [**tˤa:l**.bah] 'female student' but not to [be:.t**a**.na] 'our house'. The short and simple answer to this question is that the word [**tˤa:l**.bah] undergoes high vowel deletion, and thus NNA disfavours an epenthesis in the same place as the deletion to avoid internal CVVC syllables, yielding an ungrammatical form *[tˤa:.la.bah]. Consequently, mora-sharing and high vowel deletion are preferred over combining vowel epenthesis and deletion in the same place. On the other hand, the word [be:.t**a**.na] undergoes vowel epenthesis because it is the only phonological process in the surface form. In this case, vowel epenthesis is preferred over mora-sharing. To this end, I assume that avoiding internal CVVC syllables is favoured over having internal CVVC syllable in the grammar of NNA, except for cases when high vowel deletion is realised. In OT perspectives, we can observe that there is counterfeeding opacity. That is, we want the high vowel deletion to apply essentially after the epenthesis process, but this kind of ordered sequence is not possible within parallel OT. Hence, the theoretical interpretation of such opacity could be dealt with under Harmonic Serialism which is beyond the scope of this thesis, and it is left for future research.

All the examples in (2) avoid forbidden superheavy CVCC syllables word-internally after the derivation level through vowel epenthesis and/or onset maximisation to avoid trimoraic syllables. The adaptation of these strategies is systematic in the language. That is, vowel epenthesis is utilised as a repair strategy when a word stem CVCC syllable is attached to a consonant-initial suffix(es). For instance, the word /bint-na/ 'our daughter' surfaces as [bin.t**i**.na] in which the coda of the initial syllable is resyllabified to occupy the onset position of the following syllable and vowel epenthesis is provoked in order to affiliate the onset to the syllable node. Onset maximisation hinges on the presence of the dative suffix /l/ in derived environments. To clarify, onset maximisation strategy is provoked when a CVCC syllable is concatenated with an object vowel-initial suffix and preceded by the dative /l/ to avoid superheavy trimoraic syllables. For example, /gil-t-l-uh/ 'I said to him' is realised as [gil.**tl**uh], where the rightmost coda is resyllabified into the onset of the following syllable to avoid trimoraicity joining the dative suffix /l/ plus an object vowel-initial suffix. On the other hand, vowel epenthesis and onset maximisation should be combined and implemented to one word stem CVCC for the sake of avoiding trimoraicity syllables in a certain environment. These phonological processes are achieved if a verb and the consonant-initial subject suffix /t/ is suffixed with the dative /l/ and followed by an object consonant-initial suffix, as in /kitab-t-l-ham/ 'I wrote to them' → [ki.tab.**tla**.ham] in order to avoid trimoraic syllables. Further, we utilise vowel epenthesis here to affiliate the biconsonantal onset with the syllable node and to prevent initial triconsonantal clusters in tautosyllabic words to surface. Throughout this study, it should be noted that words like [gil.tluh] and [ki.tab.tla.ham] occur with internal -CCC- clusters. This exceptional case is realised only when a verb plus the consonant-initial subject suffix /t/ is suffixed with the dative /l/ and followed by an object suffix: a vowel-initial or a consonant-initial object suffix. Otherwise, internal -CCC- clusters are not allowed in the dialect (more detail will be shown in Chapter Four).

To conclude, NNA has shown that some CVVC and CVCC syllables are avoided in a word-internal position through certain repair strategies to satisfy the bimoraicity status. These repair strategies are vowel epenthesis and/or onset maximisation. The selection of these strategies is not randomly implemented, but they are conditioned to certain morphological restrictions.

Having provided an overview of the patterning of final and non-final heavy and superheavy CVC, CVG, CVVG, CVVC, and CVCC syllables, the next section provides an analysis of the syllabic aspects and syllabification processes of NNA. This analysis of these phonological generalisations can be achieved under the framework of an advanced phonological theory; namely, Optimality Theory (OT).

3.5 Optimality-Theoretic Analysis

In this chapter, I have presented the syllable structure features and the syllabification patterns in NNA. The most prominent features of syllable structure are the prohibition of an onsetless syllable and an empty nucleus syllable, as well as the optionality of a coda in a syllable. This means that NNA is a CV(C) language. This section aims at providing an overall perspective of OT on syllable structure and syllabification patterns in the investigated dialect. Specifically, it sheds more light on the phonological analysis of heavy CVC and CVG syllables and superheavy CVVC, CVCC, and CVVG syllables in word-final and non-final positions.

Let us begin with basic typological observations on syllable structure and see how OT can capture these generalisations by examining a set of universal violable and inviolable constraints.

These constraints are ranked based on language-specific rules. Fundamentally, the analysis of syllabification in the language will draw heavily on two types of constraints: markedness and faithfulness constraints. Prince and Smolensky (2004) proposed the basic typology of markedness and faithfulness constraints that account for basic syllable templates in NNA, as laid out in (3.8) below:

(3.8) Markedness Constraints

a. ONS

Assign one violation for each syllable which does not have an onset.

b. *CODA

Assign one violation for each syllable which has a coda.

c. NUC

Assign one violation for each syllable which does not have a nucleus.

As mentioned earlier, NNA disallows onsetless syllables and requires a nucleus in each syllable. However, a coda is an optional constituent in a syllable. The constraints in (3.8) stipulate that each syllable requires an onset and a vowel but not a coda. That is, an onsetless syllable violates the ONS constraint. In addition, a closed syllable violates the constraint *CODA once if it ends with a singleton consonant or twice if it ends with double coda consonants. Accordingly, the CV syllable satisfies all the markedness constraints in (3.8) because it constitutes an onset and a vowel but lacks a coda. Hence, this syllable shape is the least marked syllable in the dialect. As a result, the syllabic well-formedness constraints ONS and NUC are crucially ranked higher than the constraint *CODA in the grammar of NNA. In the OT mechanism, GEN will generate many syllable candidates and then EVAL will scan them based on the constraints ranking in the grammar of NNA. Accordingly, one optimal candidate will be selected from the array. To see how the basic markedness constraints presented in (3.8) interact with each other to produce a well-formed syllable in NNA, consider the following tableau shown in (3.9):

(3.9) /CVC.CV/ → [CVC.CV]

/CVC.CV/	ONS	NUC	*CODA
a. ☞ [CVC.CV]			*
b. [CVC.VC]	*!		
c. [CVC.C]		*!	*

Tableau (3.9) shows that candidate (a) is selected as the winner because it satisfies all the undominated constraints ONS and NUC by having onsets and nuclei in both syllables and allowing only for the minimal violation by incurring the dominated constraint *CODA. Candidates (b) and (c) are ruled out by the high-ranked constraints since they lack an onset and/or a nucleus, which are obligatory constituents in the grammar of NNA.

The basic faithfulness constraints can interact with markedness constraints to generate a well-formed syllable in the dialect. McCarthy and Prince (1995) introduced universal faithfulness constraints, as shown in (3.10) below:

(3.10) Faithfulness Constraints

a. DEP-IO

Assign one violation for each segment in the output which does not have a correspondant in the input. (No epenthesis)

b. MAX-IO

Assign one violation for each segment in the input which does not have a correspondant in the output. (No deletion)

The constraints in (3.10) require an input to be consistent with an output in which DEP-IO forbids epenthesis and MAX-IO forbids deletion. The markedness universal constraint ONS militates against onsetless syllables, and it is strictly inviolable because onsets are obligatory constituents in the grammar of NNA. However, the other markedness universal constraint *CODA militates against a syllable that has a coda, and it is violable since codas are optional constituents in the grammar of NNA. This argument motivates the constraint paradox in which ONS outranks *CODA in the language.

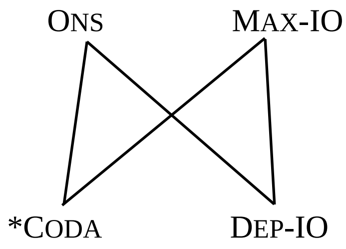
As mentioned previously, no syllables begin with a vowel in Arabic, including NNA. However, in cases where Arabic words and loanwords begin with a vowel, the glottal stop is inserted in order to obey the undominated constraint ONS in the dialect. To clarify, a prosthetic glottal stop /ʔ/ is augmented before a phrase-initial vowel and before vowel-initial loanwords. For example, the Arabic words /is.lam/ ‘Islam’ and /umma:/ ‘nation’ are realised as [**ʔ**is.lam] and [**ʔ**um.ma:] to prevent onsetless syllables to surface. Another example is English loanwords that do not usually have an equivalent word in Arabic, including NNA, as in /æs.ɪd/ ‘acid’ yielding [**ʔ**a.si:d]. Now, let us see how markedness constraints interact with faithfulness constraints, as illustrated in the tableau (3.11) below:

(3.11) /æsɪd/ → [ʔa.si:d] ‘acid’

/æsi:d/	ONS	MAX-IO	DEP-IO	*CODA
a. [æsi:d]	*!			*
b. [ʔæsi:]		*!	*	
c. ☞ [ʔæ.si:d]			*	*

We can observe from tableau (3.11) that candidate (c) is the winner by virtue of violating only the low-ranked constraints DEP-IO and *CODA. Although candidate (a) is the faithful surface form, it is ruled out from the race, confirming that a syllable with an onsetless never surfaces in the grammar of NNA. Candidate (b) loses the competition for not satisfying the high-ranked constraint MAX-IO and the low ranked constraints DEP-IO and *CODA. To sum up so far, the combined constraint ranking for the basic syllable structure inventory is outlined in (3.12) below:

(3.12) Summary constraint ranking for basic syllable structure inventory



The OT analysis for some other syllable structure properties is left for the next chapter (i.e., consonant clusters in NNA). In the next subsections, I will highlight the OT analysis of syllabification processes in the dialect.

3.5.1 Final and Non-final CVC Syllables

As stated earlier, the analysis of syllable weight is based on Moraic Theory. Recall that Moraic Theory determines the weight of each syllable: light syllables are monomoraic, heavy syllables are bimoraic, and superheavy syllables are trimoraic. The weight of a syllable is maximally bimoraic in NNA. With that in mind, to maintain the maximal bimoraicity condition we should appeal to the constraint *3μ (Kager 1999), barring trimoraic syllables from appearing in output forms in word-final and non-final positions, as defined in (3.13) below. This constraint is inviolable in the analysis of a CVC syllable of neither medial nor final word positions because a CVC syllable is bimoraic in a word-internal position due to the WBP rule. However, a CVC syllable in word-final position is monomoraic due to extrametricality status. As a result, the position of a CVC syllable in a word specifies its weight in NNA. From an OT perspective, onsets are non-moraic and weightless in the grammar of NNA, as defined in (3.14) below (Hayes 1989, 1995):

(3.13) *3μ (Kager 1999)

Trimoraic syllables are not allowed.

(3.14) *ONSET-μ (Hayes 1989, 1995)

Onsets are not moraic.

The constraint (3.13) is never violated and is therefore the top undominated constraint in NNA. In word-internal CVC syllables, the coda is moraic only by virtue of the constraint WEIGHT-BY-POSITION (WBP) (Kager 1999), as defined in (3.15) below. Hence, the constraint WBP is active in the grammar of NNA. However, this constraint is in direct conflict with the low-ranked constraint *FINAL-Cμ, which deprives a mora from being assigned to a coda in a word-final position (Kager 1999), as defined in (3.16). In the case of words ending with a consonant cluster CVCC, the *FINAL-Cμ constraint applies only to impact the final consonant (the rightmost coda) in a syllable-final position. The constraint WBP is modified and confined to an internal-word position. Accordingly, the WBP constraint should outrank the constraint *FINAL-Cμ because *FINAL-Cμ is violable in the analysis of an internal CVC syllable.

(3.15) WEIGHT-BY-POSITION (WBP)

Coda consonants are moraic in a non-final word position.

(3.16) *FINAL-Cμ

One final consonant is weightless in a syllable-final position.

The analysis of a CVC syllable in a word-internal position is demonstrated in the following tableau (3.17): (note that the second syllable is completely ignored in this tableau)

(3.17) /war.dah/ → [**war**.dah] 'rose'

μ /war.dah/	*ONSET-μ	WBP	*FINAL-Cμ
μμ a. ☞ [war.dah]			*
μ b. [war.dah]		*!	
μ μ c. [war.dah]	*!	*	
μμμ d. [war.dah]	*!		*

In the above tableau (3.17), candidate (a) surfaces as an optimal form because it respects both the undominated constraints *ONSET-μ and WBP at the expense of *FINAL-Cμ, which militates against assigning moras to codas in a final syllable. Candidate (b) is a strong rival, but it fails to meet the criterion of the undominated constraint WBP, causing the elimination of this candidate. Candidate (c) is ruled out because it fatally violates the high-ranked constraint *ONSET-μ, which proscribes assigning moras to onsets since all onsets are weightless in the language. Candidate (d) satisfies the constraint WBP, but it loses because it violates one undominated constraint *ONSET-μ and one dominated constraint *FINAL-Cμ.

In essence, the constraint WBP becomes inactive in NNA if a CVC syllable occurs word-finally. That is, the coda of a final CVC syllable is deemed extrametrical and not assigned a mora to the coda of a final syllable. In order to account for final CVC syllables under an OT point of view, we should utilise the markedness constraint *SYLLFIN-L (Bamakhramah 2009) to accommodate the analysis of word-final CVC syllables, as defined in (3.18). The constraint should be quite low-ranked in order to preserve the optimal output.

(3.18) *SYLLFIN-L (modified version of Bamakhramah's (2009) *UTTFIN-L)

An ultimate syllable cannot be light.

This constraint seems to be in serious conflict with the constraint *FINAL-Cμ. That is to say, the constraint *FINAL-Cμ motivates the extrametricality status for a coda in final CVC syllables in which a coda is deemed weightless. However, the constraint *SYLLFIN-L penalises a final light syllable, which forces final CVC syllables to be bimoraic. On that account, the constraint *FINAL-Cμ outranks *SYLLFIN-L, which provides preference to light syllables over heavy syllables to be optimised. To illustrate how these constraints are interacting with each other yielding the optimal output form, consider the following tableau (3.19): (note that the first syllable is completely ignored in this tableau)

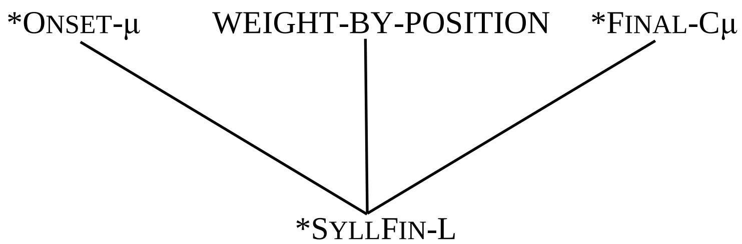
(3.19) /war.**dah**/ → [war.**dah**] 'rose'

μ /war.dah/	*ONSET-μ*	*FINAL-Cμ	*SYLLFIN-L
μμμ a. [war.dah]	*!	*	
μμ b. [war.dah]	*!		
μμ c. [war.dah]		*!	
μ d.☞[war.dah]			*

As can be noticed from tableau (3.19), candidate (d) is selected as the winner form. It obeys the high-ranked constraints *ONSET-μ and *FINAL-Cμ and only violates the low-ranked constraint *SYLLFIN-L, which bans light syllables in a syllable-final position. Candidate (a) is ruled out since the moraicity of the onset and the coda cause the violation of the undominated constraints *ONSET-μ and *FINAL-Cμ, respectively. Assigning a mora to the onset results in the elimination of candidate (b). Candidate (c) fails to satisfy the undominated constraint *FINAL-Cμ because it adds a mora to the coda in the final position.

To recapitulate, the previous tableaux (3.17) and (3.19) illustrate the moraic structure for CVC syllables in word-final and non-final positions. These tableaux manifest how the optimal candidate is selected over the other potential outputs by respecting the crucially high-ranked constraints. CVC syllables are treated differently under OT in which the WBP constraint plays an important role in determining the moraic weight of a coda (monomoraic vs. bimoraic). This constraint is active in the language when a CVC syllable occurs word-internally by granting a mora to the coda. However, the WBP rule is inactive when a CVC syllable occurs word-finally by treating the coda as an extrametrical segment (weightless). Thus, no phonological processes or repair strategies are observed because both CVC syllables in both word positions satisfy the top high-ranked constraint *3μ. By and large, consider the following Hasse diagram for the overall constraint ranking, as given in (3.20) below:

(3.20) Summary constraint ranking for final and non-final CVC syllables



After establishing an OT analysis for CVC syllables, we now turn to the analysis of the moraic weight for final superheavy CVVC and CVCC syllables in NNA in the subsequent subsection 3.5.2.

3.5.2 Final Superheavy CVXC Syllables

In this subsection, the OT analysis hinges on the undominated constraint *3μ that militates against trimoraic syllables preserving the maximal weight per syllable, which is bimoraic as previously defined in (3.13). The superheavy CVVC and CVCC syllables are tolerated in a word-final position to surface in the dialect. The constraint WBP is inactive in all superheavy syllables that occur word-finally because the final consonant is not eligible for assigning a mora to a syllable by the enforcement of WBP. Thus, to prevent assigning a mora to such codas, we should recall the constraint *FINAL-Cμ that militates against the final moraic consonant as defined earlier in (3.16) because the final consonant is considered an extrasyllabic segment in a word-final position. Furthermore, this constraint ensures that bimoraicity is respected in the grammar of NNA. To begin with, the superheavy CVCC syllable will be examined under the OT perspective. This syllable type is prosodically trimoraic based on moraic theory. Thus, the constraint *3μ should be ranked at the top of the hierarchy in order to rule out any candidate that exceeds the maximal weight of a syllable (bimoraic). To maintain the moraic structure of consonants and vowels, we rely on the general faithfulness MAX constraint in OT, which can be expressed by the constraint MAX-μ, as introduced in (3.21). More to the point, the general faithfulness constraints presented in (3.9) can be specified for vocalic or consonantal segments. That is, the constraint MAX-C militates against only consonant deletion as defined in (3.22), the constraint MAX-V militates against only vowel deletion as defined in (3.23), and the constraint DEP-V militates against only vowel epenthesis, as defined in (2.24).

(3.21) MAX-μ

Every mora in the input has a correspondent in the output.

(3.22) MAX-C

Input consonants must have output correspondents.

(3.23) MAX-V

Input vowels must have output correspondents.

(3.24) DEP-V

Output vowels must have input correspondents.

The interaction between some of these constraints is illustrated in the following tableau (3.25), which evaluates the input /nidʒaħt/ ‘I succeed’: Note: in all tableaux, the notation σ denotes that the segment is affiliated with a syllable node.

(3.25) /niʤaħt/ → [ni.ʤaħt] ‘I succeed’

μμ /ni.ʤaħt/	*3μ	MAX-μ	MAX-C	DEP-V	*FINAL-Cμ	*CODA
μμμ a. [ni.ʤaħt]	*!				*	*
μ μσ b. [ni.ʤa.ħit]		*!		*		*
μμ c. [ni.ʤaħ]			!*		*	*
μμ d. [ni.ʤaħ.ti]				*		*
μ μ e. ! [ni.ʤaħt]						*
μμσ f. ! [ni.ʤaħt]						*

In tableau (3.25), candidate (a) is ousted immediately by virtue of disrespecting the top high-ranked constraints *3μ, which bans trimoraic syllables. In candidate (b), vowel epenthesis causes the violation of the undominated constraint MAX-μ and thus it is ruled out from the competition. Candidate (c) is eliminated by the constraint MAX-C that militates against consonant deletion. Candidate (d) fails to satisfy the high-ranked constraints and incurs two violations of the low-ranked constraints. Candidates (e) and (f) satisfy the maximal weight restriction and adhere to the exact number of moras in the input, and the final consonant /t/ in both candidates is moraless. Consequently, they are equally assigned one violation of the dominated constraint *CODA. In OT grammar, one output must be selected as the winner. Thus, there should be a constraint in the grammar of NNA that favours the correct optimal form, which in this case is candidate (f), over its competitor candidate (e). We assume that the preference of candidate (f) to candidate (e) is due to the status of the last consonant in the superheavy CVCC syllable in both candidates. The question that naturally arises here is how we differentiate between the final consonant /t/ in (e) and (f) under OT terms. It should be noted that the decisive difference between these two outputs (e) and (f) is the prosodification status of the final coda consonant /t/. Candidate (e) should be ruled out because the stray segment /t/ is not affiliated with a syllable node. As a result, the current ranking constraint hierarchy is incapable of eliminating such candidates with stray consonants (codas only[29]). In order to resolve this issue, we assume a proper universal constraint that discriminates against any stray coda that is not linked to a syllable, as proposed by McCarthy (2008), as it is justified and stated in (3.26) below:

(3.26) *Cunsyll

Unsyllabified coda consonants are prohibited word-finally.

This constraint is outranked by the constraints *FINAL-Cμ and *CODA in order to select the optimal form and to rule out candidate (e). To demonstrate how these constraints play out, we should integrate the new constraint *Cunsyll in order to obtain the correct optimal output. Consider the following tableau (3.27) examining the same input as in (3.25):

(3.27) /niʤaħt/ → [ni.ʤaħt] 'I succeed'

μμ /ni.ʤaħt/	*3μ	MAX-μ	MAX-C	DEP-V	*Cunsyll	*FINAL-Cμ	*CODA
a. μμμ [ni.ʤaħt]	*!					*	*
b. μ μσ [ni.ʤa.ħit]		*!		*			*
c. μμ [ni.ʤaħ]			!*			*	*
d. μμ [ni.ʤaħ.ti]				*			*
e. μμ [ni.ʤaħt]					*		*
f. ☞ μμσ [ni.ʤaħt]							*

[29] Stray consonants are confined to codas because onsets are directly affiliated with prosodic word nodes in NNA.

Tableau (3.27) illustrates that candidate (f) is selected as an optimal form because it respects all the undominated constraints and the new constraint *Cunsyll because the last segment /t/ is parsed with the syllable node. The constraint *Cunsyll eliminates the competitor candidate (e) because it leaves the final consonant /t/ unparsed, and it becomes a stray consonant. Candidates (a), (b), (c), and (d) fail to satisfy the undominated and dominated constraints, so they immediately lose the competition. Consequently, the constraint *Cunsyll plays a central role in determining the optimal form in the analysis of internal CVCC syllables in the dialect.

After establishing the analysis of superheavy CVCC syllables, we proceed to the analysis of the non-final superheavy CVVC syllables in NNA. To ensure that the undominated constraint *3μ is satisfied, the last consonant is analysed as an extrasyllabic segment just as the analysis of the former type of superheavy syllable. Thus, the inviolable constraint *3μ should always be ranked in the top of the undominated constraints. Moreover, in order to prevent vowel shortening, we assume that an essential universal constraint that militates against vowel shortening is the faithfulness constraint IDENT(long). This constraint is adapted from McCarthy (2008) and presented in (3.28) below:

(3.28) IDENT(long)

A long vowel in the input is realised as long in the output.

The faithfulness constraint in (3.28) comes into play to ensure that a long vowel is preserved in the optimal output. The next tableau (3.29) builds on the previous constraint ranking along with others to examine the input /biba:n/ ‘doors’:

(3.29) /biba:n/ → [bi.ba:n] 'doors'

μ μ /bi.ba:n/	*3μ	MAX-C	IDENT(long)	DEP-V	*Cunsyll	*FINAL-Cμ	*CODA
a. μ μμ [bi.ba:n]	*!					*	*
b. μ μ [bi.ba:]		*!					
c. μ μ [bi.ban]			*!			*	*
d. μμ μ [bi.ba:.ni]				*			
e. μ μ [bi.ba:n]					*		*
f. ! μμ [bi.ba:n]							*
g. ! μμσ [bi.ba:n]							*

In this tableau (3.29), candidate (a) violates the undominated constraint *3μ by assigning an extra mora to the final consonant of the CVVC syllable and the low-ranked constraint *CODA. Therefore, this candidate loses the competition. Candidate (b) fails to satisfy the high-ranked constraint MAX-C for incurring a deletion of the underlying consonant. The vowel shortening process is applied to avoid trimoraic syllables causing the violation of the high-ranked constraint IDENT(long). Thus, candidate (c) is ruled out of the competition. Candidate (d) resyllabifies the coda into an onset of the following syllable and inserts a vowel to affiliate an onset with the syllable. Hence, it loses because it violates the constraint DEP-V. Candidate (e) fails to satisfy the dominated constraint *Cunsyll because the last consonant does not associate with a syllable node. Candidates (f) and (g) satisfy all the high-ranked constraints and only violate the same dominated constraint *CODA. Eventually, we come up with only one optimal form, which is candidate (g) over its competitor candidate (f). In this sense, candidate (f) should be ruled out in order to select the optimal form successfully, since mora sharing is not allowed in the domain-final word position in the grammar of NNA. Hence, one supplementary constraint is required at the expense of avoiding the mora-sharing rule due to the effectiveness of the extrasyllabicity condition in a word-final position. Broselow *et al*. (1997) proposed a constraint that bans sharing a mora with a preceding vowel. This constraint is defined below in (3.30):

(3.30) NOSHAREDMORA (NSμ)

Moras in the output are linked to a single segment.

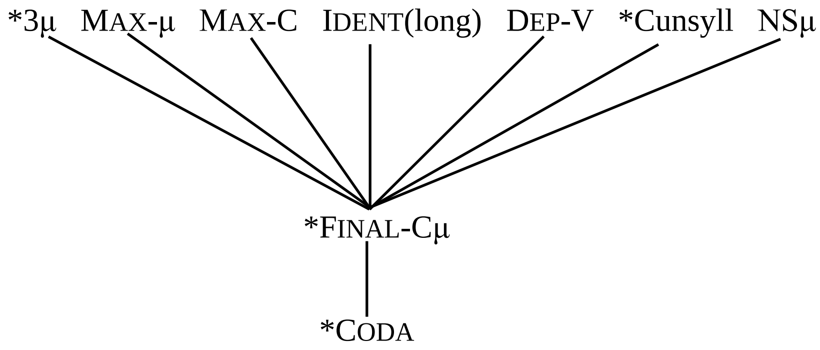
To consolidate this constraint into the previous ranking argument, it should be outranked by the constraint *Cunsyll in order to rule out any candidate that shares a mora with the preceding vowel in a syllable-final position. To illustrate this, we should reconsider the analysis of the same input /biba:n/ with the latest constraint ranking. In the following tableau (3.31) it can be seen that the constraint NSμ plays a crucial role in getting rid of candidate (g) from being an optimal form. Thus, candidate (a) perfectly emerges as the winner form since it satisfies all the undominated constraints and shows the minimal violation of the low-ranked markedness constraint *CODA. Candidates (b), (c), and (d) are eliminated because they violate at least one high-ranked constraint. In contrast, candidate (f) is the strongest rival as it satisfies all the undominated constraints except one dominated constraint. Finally, candidate (e), is ruled out because it violates the DEP-V.

(3.31) /biba:n/ → [bi.ba:n] ‘doors’

μ μ /bi.ba:n/	*3μ	MAX-C	IDENT(long)	DEP-V	*Cunsyll	NSμ	*FINAL-Cμ	*CODA
μμ σ a. ☞ [bi.ba:n]								*
μμμ b. [bi.ba:n]	*!						*	*
μ μ c. [bi.ba:]		*!						
μμ d. [bi.ban]			*!				*	*
μ μ μ e. [bi.ba:.ni]				*				
μ μ f. [bi.ba:n]					*			*
μμ g. [bi.ba:n]						*		*

Summarising thus far, we have seen that the OT analysis of superheavy CVVC and CVCC syllables in a word-final position is dependent on the preservation of bimoraicity and parsing the last consonant with a syllable node. This can be achieved by satisfying the two constraints *3μ and *Cunsyll. Based on the previous constraint ranking, the general constraint ranking hierarchy for superheavy CVVC and CVCC syllables are given below in (3.32):

(3.32) Summary of unified constraint ranking for CVVC and CVCC syllables word-finally



After establishing the OT analysis for final superheavy CVCC and CVVC syllables, we now move on to the analysis of the moraic weight for heavy CVG and superheavy CVVG syllables in a word-final position in the subsequent subsection 3.5.3.

3.5.3 Internal CVG and CVVG Syllables

Within Moraic Theory, geminate consonants are deemed to be weight-bearing units in which they are underlyingly moraic as vocalic segments behave in the theory. Therefore, a geminate consonant is always linked to a single mora (monomoraic) in the grammar of NNA. In this case, an internal CVC syllable is treated similarly in terms of moraic weight since the coda of this syllable is mortified by the WBP rule. Consequently, it can be noted that CVG syllables do not violate the undominated constraint *3μ due to the commitment of the bimoraic maximal syllable weight requirement. In multisyllabic words, non-final geminates are attached to suffixes where geminates always occur in heterosyllabic environments. That is, the suffixation to the stem of non-final CVG syllables can be divided into two parts. First, consonant-initial suffix words where the geminate consonants are syllabified as a coda of an initial syllable and an onset of the following one. Furthermore, vowel insertion is applied in order to affiliate the second leg of the geminate with a syllable and to prevent medial triconsonantal clusters to surface with these forms such as /ʕam:-kam/ ‘your uncle’ → [ʕam.mi.kam]. Second, vowel-initial suffix words where the production of a CVG syllable after suffixation is achieved by syllabifying the first member of a geminate as a coda of an initial syllable and an onset of the following one, such as /ʕam:-uh/ ‘his uncle’ → [ʕam.muh]. Thus, no repair strategies or phonological processes are implemented since there is no violation of the high-ranked constraint *3μ and the bimoraicity is met in both parts. It should be noted, however, that a final CVG syllable is avoided via degemination in morphological complex words in the language where a geminate becomes a singleton consonant, and that consonant is deemed as extrametrical word-finally. As a result, the final CVG syllables do not surface in morphological complex words. This can be observed when a verb is attached with prefixes like the definite article ʔal-, ji-, or ti-. For example, the final geminates in /ji-ʃid:/ ‘he pulls’, /ti-mid:/ ‘she spreads’, and /ʔal-ham:/ ‘the distress’ undergo degemination, yielding [ji.ʃid], [ti.mid], and [ʔal.ʕam] (cf. Prochazka 1988: 21, Alhuwaykim 2018: 88).

With respect to a CVVG syllable in a word-internal position, following Broselow *et al.* (1997) and Watson (2007), a geminate in a word-medial position shares a mora with the preceding vowel to avoid violating the undominated constraint *3μ. In NNA, potential CVVG syllables can be concatenated with vowel-initial suffix words and realised by resyllabifying the second leg of a geminate as an onset of the following syllable. Also, we have observed that vowel epenthesis is employed only with consonant-initial suffix words in order to affiliate the second part of a geminate with a syllable and to ban medial -CCC- clusters with these certain forms.

Before analysing an internal CVG, an OT analysis will be provided for the avoidance of a final CVG syllable in the dialect. This behaviour is achieved by the phonological process of degemination where the final geminate undergoes degemination in morphological complex words. To achieve this process, we adopt a constraint that forbids final geminate to surface in the language. In doing so, the following constraint shown in (3.33) is adopted:

(3.33) *FINAL-G

Word-final geminates are prohibited in multisyllabic words.

This constraint is undominated in the grammar of NNA in order to rule out any candidate with final germinates in disyllabic words. As mentioned earlier, geminate consonants are moraic. However, the underlying geminate becomes an extrametrical consonant in the surface form. To translate this process in OT, we utilise the constraint *FINAL-Cμ to motivate the notion of extrametricality and to eliminate any moraic codas in a word-final position. The following tableau (3.34) shows the evaluation of degemination in NNA:

(3.34) /ji-ʃid:/ → [ji.ʃid] 'he pulls'

μ /ji.ʃid:/	*3μ	*FINAL-G	*FINAL-Cμ	*SYLLFIN-L
μ a. ☞ [ji.ʃid]				*
μμμ b. [ji.ʃid]	*!		*	
μ c. [ji.ʃid:]		*!		
μμ d. [ji.ʃid:]		*!	*	

Tableau (3.34) shows that candidate (a) is selected as the winner because the final geminate is degeminated and the final coda consonant is considered as extrametrical. Candidate (b) loses because it fatally violates the most undominated constraint *3μ as it exceeds the maximal weight in the language. Candidate (c) is ruled out due to the violation of the high-ranked constraint *FINAL-G. Finally, candidate (d) fails to satisfy two undominated constraints because it maintains the final germinate and assigns a mora to it in the surface form.

Now, the optimality-theoretic analysis for internal CVG syllables will be presented in terms of moraic weight. As mentioned earlier, all non-final geminates are heterosyllabic or ambisyllabic in disyllabic words. Thus, heterosyllabic geminates are inviolable and should be high-ranked in the grammar of NNA. To achieve this under the tenets of OT, the pertinent constraint that eliminates all non-final geminates that appear in tautosyllabic contexts after suffixation will be presented. The suggested constraint is adjusted from Grimes (2002) to fit into the current analysis, as presented in (3.35) below:

(3.35) *COMPLEX-G

No tautosyllabic geminates in multisyllabic words.

Consider the following tableau (3.36), which demonstrates how some former constraints assist to pick out the optimal candidate for the input concatenated with a vowel-initial suffix /ʕum:-ah/:

(3.36) /ʕum:-ah/ → [ʕum.mah] 'her mother'

μ | /ʕum:ah/	*3μ	*COMPLEX-G	*FINAL-Cμ
μμ | | a. ☞ [ʕum.mah]			*
μμμ | | | b. [ʕum.mah]	*!		*
μ | c. [ʕu.m:ah]		*!	

We have accounted for non-final CVG syllables within the OT framework in NNA. It should be observed that candidate (a) is selected as the winning output because it obeys all the undominated constraints *3μ, WBP, and *COMPLEX-G because it does not exceed the limit weight per syllable, assigns mora to the coda in a word-medial position, so the geminate occurs in two adjacent syllables. Candidate (b) is eliminated because it incurs one violation of the highest-ranked constraint *3μ and one violation of the low-ranked constraints. Lastly, candidate (c) is ruled out because it violates the constraint *COMPLEX-G in which the geminate occurs in tautosyllabic contexts.

After analysing a CVG syllable with a vowel-initial suffix, a CVG syllable with a consonant-initial suffix will now be accounted for. To do so, vowel epenthesis is applied in order to prevent -CCC- sequences and to affiliate the second leg of a geminate with a syllable. Thus, the faithfulness constraint DEP-V and the markedness constraint *-CCC-[30] should be adopted to

[30] I add dashes before and after the constraint *CCC to indicate that this constraint is limited to internal triconsonantal clusters (across syllables) not to an onset or a coda triconsonantal cluster. Note that I will introduce the constraint *CCC to represent the ban on an onset or a coda triconsonantal cluster.

account for a CVG syllable with a consonant-initial suffix. The constraint *-CCC- is modified and defined in (3.37) below:

(3.37) *-CCC- (McCarthy and Prince 1995)

A sequence of internal three consonant clusters is not allowed in the output.

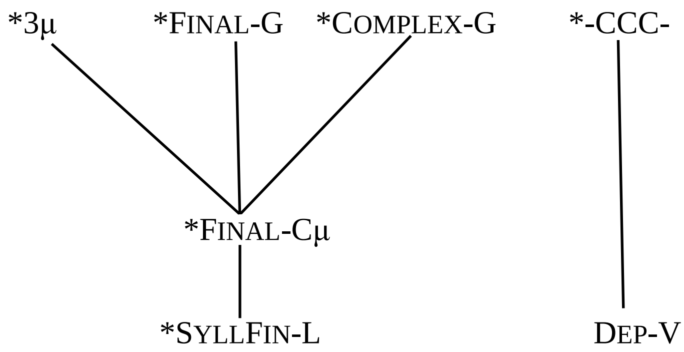
This constraint is satisfied when vowel epenthesis is employed after suffixation. Otherwise, the constraint *-CCC- is vulnerable to violation. These constraints conflict with each other and *-CCC- outranks DEP-V in the grammar of NNA to rule out any candidate occurring with internal -CCC- sequences. The following tableau (3.38) demonstrates how some former and current constraints select the winner candidate for the input concatenated with a vowel-initial suffix /ʔum:-kam/.

(3.38) /ʔum:-kam/ → [ʔum.ma.kam] 'your (pl.) mother'

μ /ʔum:-kam/	*3μ	*COMPLEX-G	*-CCC-	DEP-V	*FINAL-Cμ
μμ a. ☞ [ʕum.ma.kam]				*	*
μμμ b. [ʕum.ma.kam]	*!			*	*
μ c. [ʕu.m:a.kam]		*!		*	
μ μ d. [ʕum.mkam]			*!		*

The tableau shows how vowel epenthesis prevents internal triconsonantal clusters to surface in the language Candidate (a) emerges as the winner form by virtue of satisfying all the undominated constraints and allows for only a minimal violation. Candidate (d) does not allow vowel epenthesis after suffixation, which leads to violation of the low-ranked constraint *-CCC-. Thus, it is eliminated from the competition. Candidates (b) and (c) are ruled out because they violate various undominated constraints.To sum up so far, the overall ranking constraint hierarchy for the CVG analysis is introduced in (3.39):

(3.39) Summary constraint ranking for final and non-final heavy CVG syllable



After presenting the analysis of CVG syllables in NNA, let us move on to the analysis of internal superheavy CVVG syllables. To avoid potential trimoraic CVVG syllables, the mora sharing rule is applied in which the first part of a geminate shares a mora with the preceding vowel since the second part of a geminate is resyllabified into an onset of the following syllable. Moreover, vowel epenthesis is implemented only when a CVVG is concatenated with a consonant-initial suffix to avoid internal three consonant clusters in the language. To translate these strategies into OT terms, consider the following tableaux in (3.40) and (3.41) for an evaluation of a potential CVVG syllable word-internally in two different inputs:

(3.40) /ʤa:d:-ah/ → [ʤa:d.dah] 'serious (fem.)'

μ μ /ʤa:d:-ah/	*3μ	*COMPLEX-G	MAX-C	IDENT (long)	NSμ	*FINAL-Cμ
μ μ a. ☞ [ʤa:d.dah]					*	
μμ μ b. [ʤa:d.dah]	*!					*
μ μ d. [ʤa:.d:ah]		*!				
μ μ e. [ʤa:.dah]			*!			
μμ f. [ʤad.dah]				*!		*

Candidate (a) is selected as an optimal output in tableau (3.40). It respects the ban on trimoraic syllables and other high-ranked constraints. Candidate (b) is eliminated immediately for incurring a fatal violation under the top high-ranked markedness constraint *3μ. Appending the high-ranked constraint *COMPLEX-G is inevitable since the composition of a geminate in the dialect never occurs in tautosyllabic contexts in the derived environments. Thus, candidate (c) violates the undominated constraint *COMPLEX-G because the geminate is not split across two adjacent syllables. Candidate (d) is ruled out because it deletes one member of the geminate. In candidate (e), vowel shortening is utilised as a repair strategy to avoid trimoraicity, resulting in its elimination by the constraint IDENT(long), which bans vowel shortening.

After analysing a CVVG syllable with a vowel-initial suffix, a CVVG syllable attached to a consonant-initial suffix will now be accounted for. With this type of suffix, vowel epenthesis is applied to prevent *-CCC- sequences and to affiliate the second leg of a geminate with a syllable. Thus, we should show the interaction between the faithfulness constraint DEP-V and the markedness constraint *-CCC- in order to obtain the optimal form. These constraints are ranked similar to the previous constraint ranking in (3.40). Consider the following tableau (3.41), which examines a CVVG syllable, followed by a consonant-initial suffix as in /ðˤa:m:-kam/:

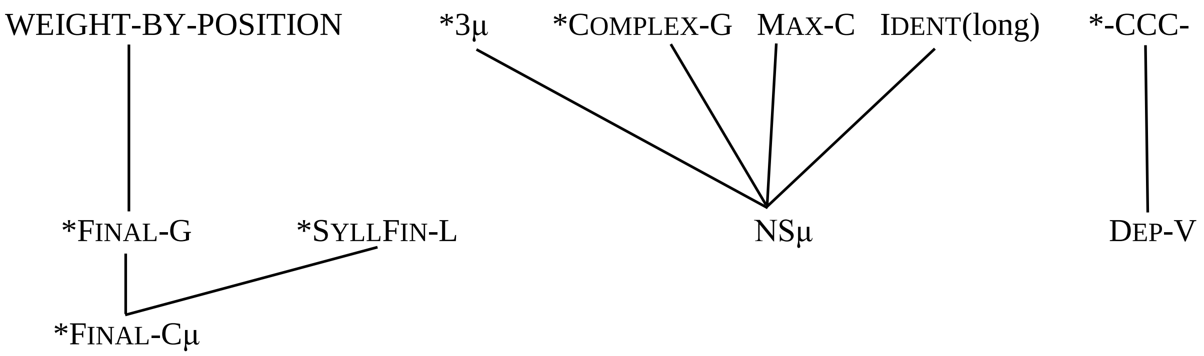
(3.41) /ðˤa:m:-kam/ → [ðˤa:m.mi.kam] 'he included you (pl.)'

μ μ /ðˤa:m:-kam/	*3μ	*COMPLEX-G	MAX-C	IDENT(long)	*-CCC-	DEP-V	NSμ	*FINAL-Cμ
μ μ a. ☞ [ðˤa:m.mi.kam]						*	*	
μ μ μ b. [ðˤa:m.mi.kam]	*!							*
μμ μ c. [ðˤa:.m:i.kam]		*!				*		
μ μ d. [ðˤa:.mkam]			*!					
μ μ e. [ðˤam.mi.kam]				*!				*
μμ f. [ðˤa:m.mkam]					*!		*	

Based on tableau (3.41), candidate (a) shows the minimal violation of the low-ranked constraints DEP-V and NSμ and it satisfies all the high-ranked constraints. Accordingly, this candidate is selected as the winner form. Candidate (b) forfeits optimality due to the violation of the most undominated constraint *3μ by assigning three moras to the CVVG syllable and the violation of some low-ranked constraints. The high-ranked constraint *COMPLEX-G is eligible for excluding candidate (c) from the race since the composition of a geminate in the dialect never occurs in tautosyllabic contexts postlexically. Candidate (d) fails to satisfy the relatively high-ranked faithfulness constraint MAX-C for simply deleting the rightmost geminate (degemination) from the input in order to avoid trimoraic syllables. The vowel shortening process is not preferred as a repair strategy to avoid trimoraic syllables in the dialect resulting in the elimination of candidate (e). In candidate (f), satisfying the vowel epenthesis process leads to a fatal violation of the low-ranked constraint *-CCC-.

To sum up so far, I have furnished an OT analysis to account for internal and final heavy CVG syllables and internal superheavy CVVG syllables, which show that the bimoraicity constraint is respected and maintained in the grammar of NNA. As can be noted from an OT analysis, the constraints NSμ and *3μ, along with other markedness and faithfulness constraints offer relatively clear-cut evidence showing that non-final CVVG syllables surface as bimoraic since the last geminate consonant shares a mora with the preceding vowel to avoid trimoraicity. Generally, the constraints that are responsible for the analysis of CVG and CVVG syllables are summarised in (3.42):

(3.42) Summary constraint ranking for non-final superheavy CVVG syllables



3.5.4 Internal Superheavy CVVC Syllables

A potential CVVC syllable occurs word-internally, and it is not avoided by repair strategies or phonological processes in the understudied dialect. That is, an internal CVVC syllable can be seen as a result of morphological concatenation in the derived environment. The syllabic weight of a potential CVVC syllable is trimoraic based on Moraic Theory. Thus, these syllables maintain trimoraicity when no repair strategies or phonological processes are applied as a way of avoiding trimoraic syllables, i.e., vowel shortening or onset maximisation. However, if we consider CVVC syllables as bimoraic, then how do we treat the final consonant of CVVC syllables to prevent trimoraicity? This question has been clearly addressed in the discussion in subsection 3.4.2.4.

In this subsection, superheavy CVVC syllables will be examined within OT. If we look at a CVVC syllable, we infer that this potential syllable shape is deemed as trimoraic based on Moraic Theory. Therefore, the top high-ranked constraint *3μ should be satisfied because of the mora sharing rule. Thus, we should recall the constraint NSμ, which should be ranked lower in order to maintain the maximum syllable weight (bimoraic) and to select the optimal output correctly.

It should be noted that a potential non-final CVVC syllable emerges as a result of either vowel epenthesis or deletion when the word stem is morphologically concatenated with a suffix. In OT terms, I will adopt the constraint *i]σ which militates against high vowels in open light syllables. This constraint should be ranked lower to satisfy high vowel epenthesis and deletion. The new constraint is defined below in (3.43):

(3.43) *i]σ (Kenstowicz 1996)

High short unstressed vowels in open syllables are not allowed.

In the next tableau, the implementation of vowel epenthesis prevents a sequence of internal three consonants to surface in the language. The constraint DEP-V is in direct conflict with the constraint *-CCC-, which militates against a sequence of internal three consonants. The constraint *i]σ is in direct conflict with the realisation of some internal CVVC forms in the dialect. Now, I will analyse non-final CVVC syllables that co-occur with a vowel insertion in tableau (3.44) and then with the high vowel deletion in tableau (3.47) below. Consider the overall evaluation of the input /**ba:ħ**-l-kam/ in the following tableau (3.44):

(3.44) /ba:ħ-l-kam/ → [ba:ħ.la.kam] ‘he revealed to you (pl.)’

μ μ /ba:ħ-l-kam/	*3μ	WBP	MAX-C	IDENT(long)	*-CCC-	DEP-V	NSμ	*FINAL-Cμ
μ μ μ a. ☞ [ba:ħ.la.kam]						*	*	
μμ μ μ b. [ba:ħ.la.kam]	*!							*
μμ μ c. [ba:ħ.la.kam]		*!				*		
μμ μ d. [ba:.la.kam]			*!					
μμ μ e. [baħ.la.kam]				*!				*
μ μ f. [baħ.lkam]				*!	*			*
μ μ g. [ba:ħ.lkam]					*!		*	

Tableau (3.44) selects candidate (a) as the optimal output by virtue of satisfying the high-ranked constraints and violating only two low-ranked constraints. Candidate (b) is ruled out in favour of candidate (a) because it fails to respect the most undominated constraint *3μ by assigning three moras to the initial syllable and violating two of the low-ranked constraints. Even though candidate (c) satisfies the constraint DEP-V, it is eliminated by constraint WBP because it fails to allocate moraic weight to the coda of the non-final CVVC syllable. Consonant deletion is employed in order to avoid violation of the most undominated constraint *3μ, but it loses due to violation of the high-ranked constraint MAX-C. In candidates (e) and (f), vowel epenthesis is utilised as a repair strategy to avoid trimoraicity. However, two diverse violations lead to the elimination of these candidates. Candidate (g) respects the undominated constraint *i]σ but it causes violation of the constraint *-CCC- as well as constraint NSμ due to adaptation of the mora sharing rule.

In the next tableau, I will analyse the moraic weight of non-final CVVC syllables as a result of the high vowel deletion after suffixation. For instance, the underlying form /tˤa:lib-ah/ ‘female student’ surfaces as [tˤa:l.bah], where the high vowel is syncopated, allowing CVVC syllables to surface word-internally. To translate this behaviour into OT terms, we should meditate on the direct conflict between the low-ranked constraint *i]σ that resists high vowels in open syllables and the faithfulness constraint MAX-μ-V that resists their moraic deletion. This constraint MAX-μ-V was introduced broadly in (3.21); however, it should be stated more specifically to serve only vocalic mora deletion, as defined in (3.45):

(3.45) MAX-μ-V

Every vocalic mora in the input has a correspondent in the output.

A constraint that militates against an onset maximisation process as a repair strategy to avoid trimoraicity should be adopted here. This would help rule out any candidate that syllabifies the final consonant of a CVVC syllable into the onset of the following syllable. This constraint is stated in (3.46) below:

(3.46) *COMPLEX^{ONS} *[σ CC (Kager 1999)

Onsets are simple.

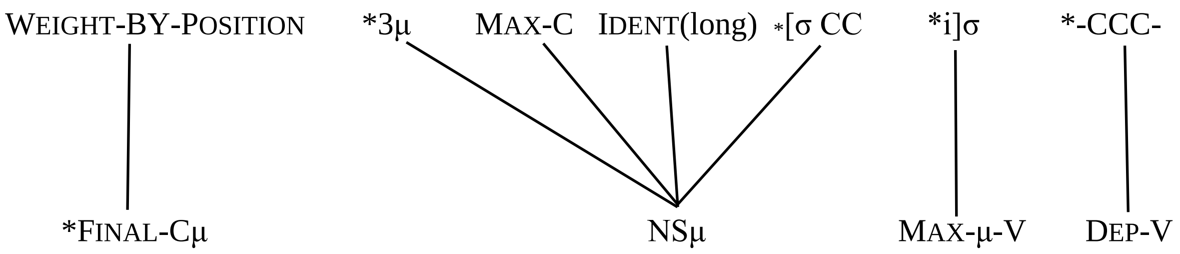
To clarify how these constraints interact with each other in order to select the correct surface form in NNA, consider the overall evaluation of the input /tˤa:lib-ah/ in the following tableau (3.47):

(3.47) /tˤa:lib-ah/ → [tˤa:l.bah] 'female student'

μμ μ /tˤa:lib-ah/	*3μ	WBP	MAX-C	IDENT(long)	MAX-μ-V	*i]σ*	*[σ CC	NSμ	*FINAL-Cμ
μ μ a. ☞ [tˤa:l.bah]					*			*	
μμμ b. [tˤa:l.bah]	*!				*				*
μμ c. [tˤa:l.bah]		*!			*				
μμ μ d. [tˤa:.li.ba]			*!			*			
μ μ e. [tˤa.li.bah]				*!		*			
μ f. [tˤa.lbah]				*!			*		

From the general evaluation established in tableau (3.47), we observe that candidate (a) is selected as the winner by respecting all the undominated constraints and being allowed to minimally violate two dominated constraints. Candidate (b) is ruled out immediately since it violates the top high-ranked constraint *3μ. Candidate (c) loses the race due to failure to assign a mora to the coda of the non-final CVVC syllable. Candidate (d) fails to satisfy the undominated constraint MAX-C by deleting a consonant from the input and the dominated constraint *i]σ*, which bans the high vowel /i/ in light syllables. Candidates (e) and (f) are ruled out by the high-ranked constraint IDENT(long) and two different low-ranked constraints. All in all, the constraints that are accounted for the analysis of superheavy CVVC syllables as a result of the high vowel syncope or epenthesis are outlined in (3.48):

(3.48) Summary constraint ranking for non-final superheavy CVVC syllables



Although non-final CVVC syllables are licit in NNA, sometimes it can be avoided with other forms by applying certain repair strategies in order to avoid trimoraic syllables. To illustrate this behaviour under the framework of Optimality Theory, the treatment of non-final superheavy CVVC and CVCC syllables will be introduced in the following subsection 3.5.5, along with the OT analysis.

3.5.5 The Avoidance of Internal Superheavy CVXC Syllables

It can be noted from the discussion in 3.4.2.5 that some internal superheavy CVVC and CVCC syllables are avoided through certain repair strategies. These strategies are utilised for both superheavy syllables in order to prevent the risk of creating potential internal trimoraic syllables in NNA. After attesting these superheavy syllables word-internally, we revealed that these syllables are avoided by the repair strategies: vowel epenthesis and/or onset maximisation. Each repair strategy is elaborated and analysed under the OT below.

1. **Vowel Epenthesis**

In non-final CVVC and CVCC syllables, the last consonant is resyllabified into the onset of the following syllable and then a vowel is epenthesised to affiliate it with a syllable. This strategy is employed when CVVC or CVCC syllables are concatenated with a consonant-initial suffix. For instance, the underlying representations /ʃa:f-ham/ ‘he saw them (mas.)’ and /kalb-ham/ ‘their dog’ are realised as [ʃa:.f**a**.ham] and [kal.b**a**.ham], where the low vowel /a/ is inserted after an onset in order to affiliate the final consonant with the syllable node. Thus, the final consonant /f/ forfeits its moraicity by being resyllabified as the onset of the second syllable in which onsets are moraless in NNA. In OT terms, the faithfulness constraint DEP-V and the markedness constraint *[σ CC are violable and ranked lower in the grammar of NNA in order to obtain the optimal form. The faithfulness and markedness constraints will be incorporated in the next tableaux in order to evaluate the inputs /be:t-na/ ‘our house’, and /kalb-na/ ‘our dog’, respectively, as shown in (3.49) and (3.50):

(3.49) /be:t-na/ → [be:.ta.na] ‘our house’

μμ /be:t-na/	*3μ	WBP	MAX-C	IDENT(long)	DEP-V	*FINAL-Cμ
μμ μ a.☞ [be:.ta.na]					*	
μμμ b. [be:t.na]	*!					*
μμ c. [be:t.na]		*!				
μ μ d. [be:.na]			*!			
μμ e. [bet.na]				*!		*

The analysis of potential CVVC and CVCC syllables shows that trimoraicity is avoided through vowel epenthesis. As a result, the most undominated constraint *3μ is satisfied. Candidate (a) emerges as the winner by virtue of satisfying all the undominated constraints and allowing violation of only one dominated constraint. Candidates (b) and (c) are eliminated due to violation of the high-ranked constraints *3μ or WBP. Candidate (d) loses due to the consonant deletion process, which leads to the violation of the high-ranked constraint MAX-C. Finally, candidate (g) respects the most undominated constraints *3μ and WBP through a vowel shortening strategy. However, this strategy leads to violation of the undominated constraint IDENT(long), and thus it is ruled out of this competition.

(3.50) /kalb-na/ → [kal.ba.na] ‘our dog’

μμ /kalb-na/	*3μ	WBP	MAX-C	DEP-V	*FINAL-Cμ
μμ μ a.☞ [kal.ba.na]				*	
μμμ b. [kalb.na]	*!				*
μμ c. [kalb.na]		*!			
μμ d. [kal.na]			*!		*

In tableau (3.50), the constraint IDENT(long) is ignored because the input comprises only short vowels. Otherwise, the analysis has gone through the same procedures as in tableau (3.49). To clarify, the violation of the constraint DEP-V assists candidate (a) to satisfy the undominated constraints and to be selected as the optimal form in this tableau.

2. Onset Maximisation and Vowel Epenthesis

Superheavy CVVC and CVCC syllables are avoided through vowel epenthesis and onset maximisation to satisfy the undominated constraint *3μ in derived environments. Both strategies are gathered and utilised as a repair strategy when superheavy syllables are concatenated with a consonant-initial suffix and preceded by the dative suffix /l/ to avoid internal CVCC and CVCC syllables. For example, the underlying forms /ʤa:b-l-ham/ ‘he brought to them’ and /kitab-t-l-kam/ ‘I wrote to you (pl.)’ are realised as [ʤa:.**bla**.ham] and [ki.tab.**tla**.ham]. Thus, the final coda of superheavy syllables is resyllabified into the onset of the following syllable joining the dative suffix /l/ to form a complex onset and vowel epenthesis is applied to affiliate a complex onset with a syllable and to avoid initial CCC syllables. A constraint that militates against initial triconsonantal clusters is defined in (3.51), which should be ranked relatively higher in the grammar of NNA:

(3.51) *σ[CCC (McCarthy and Prince 1995)

A sequence of syllable-initial triconsonantal clusters is not allowed in the output.

In OT grammars, an onset maximisation process produces an internal biconsonantal onset cluster, but this behaviour does not affect the analysis since complex onsets are tolerated in NNA and then the constraint *[σ CC should be low-ranked in order to optimise the correct candidate. The constraint *σ[CCC is inviolable in the grammar of NNA, which can be satisfied by the violation of the faithfulness constraint DEP-V. Consider the following tableaux (3.52) and (3.53), which evaluate two different inputs to show how onset maximisation and vowel epenthesis are adopted to avoid potential CVVC and CVCC syllables in NNA:

(3.52) /ʤa:b-l-ham/ → [ʤa:.bla.ham] 'he brought to them'

μμ /ʤa:b-l-ham/	*3μ	WBP	MAX-C	IDENT (long)	*σ[CCC	DEP-V	*FINAL -Cμ	*[σ CC
μμ a. ☞ [ʤa:.bla.ham]						*		*
μμμ b. [ʤa:b.lham]	*!						*	*
μμ c. [ʤa:b.lham]		*!						*
μμ d. [ʤa:.ham]			**!					
μμ μ e. [ʤab.la.ham]				*!		*	*	
μμ f. [ʤa:.blham]					*!			*

In tableau (3.52), candidate (a) is selected as the optimal output in which it violates the low-ranked constraints *3μ and *[σ CC to satisfy the high-ranked constraints. Candidate (b) falls victim to the most undominated constraint by assigning three moras to the initial syllable, so it is ruled out. This leaves the final consonant of the initial syllable demoraified causing the elimination of candidate (c) by the high-ranked constraint WBP. Candidate (d) loses due to the violation of the high-ranked constraint MAX-C by deleting two consonants from the underlying form. A vowel shortening strategy leads to the violation of the undominated constraint IDENT (long), thus candidate (e) is removed from the competition. Candidate (f) loses because the violation of the DEP-V leads to violation of the undominated constraint *σ[CCC by forming an initial triconsonantal cluster, which is forbidden in the language.

(3.53) /risam-t-l-kam/→ [ri.sam.tla.kam] ‘I drew to you (pl.)

μ μμ /risam-t-l-kam/	*3μ	WBP	MAX-C	*σ[CCC	DEP-V	*FINAL-Cμ	*[σ CC
μ μμ μ e. ☞ [ri.sam.tla.kam]					*	*	*
μ μμμ μ a. [ri.samt.la.kam]	*!				*	*	
μ μμ b. [ri.samt.lkam]		*!					*
μ μμ μ c. [ri.sam.la.kam]			*!		*	*	
μ μ μ d. [ri.sam.tlkam]				*!		*	*
μ μμ μ μ e. [ri.sam.ta.la.kam]					*!*	*	

Candidate (a) is selected as the winner form because it respects the most undominated constraints *3μ and WBP by means of onset maximisation and vowel epenthesis at once. Candidate (e) is a strong competitor, but it fails because it incurs two violations of the same low-ranked constraint DEP-V. Candidates (b), (c), and (d) are ruled out because each candidate fatally violates one of the undominated constraints and at least one of the dominated constraints.

3. Onset Maximisation

The process of onset maximisation is applied in order to avoid potential trimoraic CVVC and CVCC syllables. It should be noted that this strategy is utilised when superheavy syllables are concatenated with an object vowel-final suffix and preceded by the dative suffix /l/. The reason for not adopting vowel epenthesis as a repair strategy is due to the presence of an underlying vowel to affiliate an onset cluster with a syllable. For instance, the underlying forms /raːħ-l-ah/ 'he went to her' and /gil-t-l-uh/ 'I said to him' are realised as [raː.**ħl**ah] and [gil.**tl**uh], where the final consonant of superheavy syllables is resyllabified to the onset of the following syllable joining the dative suffix /l/ to form an initial biconsonantal cluster. All in all, it seems that the onset maximisation process is limited to the combination of [tl] when they occur as the first and second suffixal morphemes in the dialect. To better understand the OT analysis, consider the following tableaux shown in (3.54) and (3.55) for an evaluation of a potential form of internal CVVC and CVCC syllables, where the onset maximisation is employed to avoid trimoraicity.

(3.54) /raːħ-l-ah/ → [raː.**ħl**ah] 'he went to her'

μμ /raːħ-l-ah/	*3μ	WBP	MAX-C	IDENT (long)	DEP-V	*FINAL-Cμ	*[σ CC
μμ a.☞ [raː.ħlah]							*
μμμ b. [raːħ.lah]	*!					*	
μμ c. [raːħ.lah]		*!					
μμ d. [raː.ħla]			*!				*
μμ e. [raħ.lah]				*!		*	
μμ f. [raː.ħi.lah]					*		

(3.55) /gil-t-l-uh/ → [gil.**tl**uh] 'I said to him'

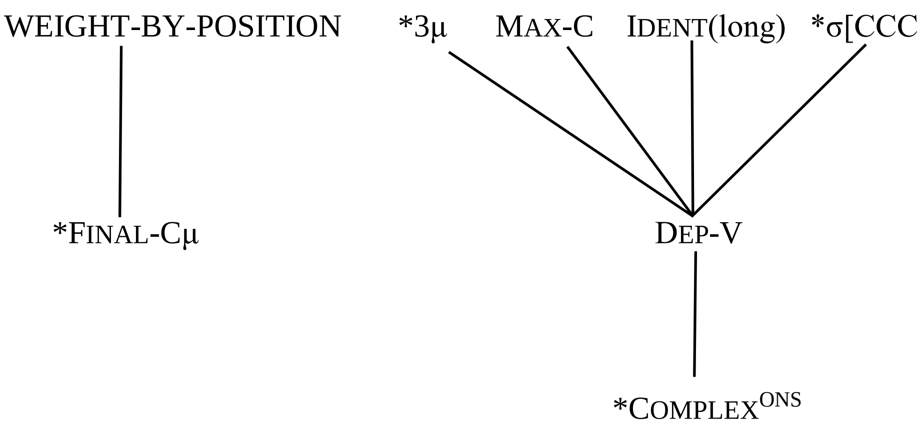
μμ /gil-t-l-uh/	*3μ	WBP	MAX-C	DEP-V	*FINAL-Cμ	*[σ CC
μμ a. ☞ [gil.tluh]					*	*
μμμ b. [gilt.luh]	*!				*	
μμ c. [gilt.luh]		*!				
μμ d. [gil.luh]			*!		*	
μμ e. [gil.ti.luh]				*	*	
μ μ f. [gi.li.tluh]				*		*

In tableau (3.54), candidate (a) emerges as the winner in the evaluation because an onset maximisation strategy is applied to avoid an internal superheavy CVCC syllable to satisfy the high-ranked constraints. Assigning three moras to candidate (b) in the non-final CVCC syllable results in violation of the most undominated constraint *3μ, which leads to violation of the low-ranked constraint *FINAL-Cμ. Thus, this candidate is eliminated from being optimal. Candidate (c) is eliminated because it fails to satisfy the undominated constraint WBP, where the final consonant of an internal syllable is moraless. Vowel shortening and consonant deletion cause the elimination of candidates (d) and (e) from the race. Finally, candidate (f) favours a vowel epenthesis strategy over an onset maximisation strategy, which leads to the elimination by the dominated constraint DEP-V.

Tableau (3.55) below is very similar to the previous one; that is, candidate (a) is the optimal form by applying the onset maximisation process to satisfy the most undominated constraint *3μ and other high-ranked constraints. Candidates (b) and (c) are ruled out for incurring violation of the undominated constraints by assigning three moras or leaving the final consonant demoraified. Candidates (d) and (e) lose the competition by virtue of disrespecting the high-ranked constraints MAX-C or IDENT(long). Candidate (f) splits the potential internal onset cluster by a vowel epenthesis process, which is disfavoured in this subsection, thus it is ruled out.

After establishing an OT analysis for the avoidance of non-final CVVC and CVCC syllables, we can now present a concluding constraint ranking for the two superheavy syllables which manifests how the most faithful output is selected as the optimal form over the other potential outputs. The general constraint ranking for internal CVVC syllables with various repair strategies to avoid trimoraicity is listed under (3.56):

(3.56) Summary constraint ranking for the avoidance of non-final CVVC and CVCC syllables



To summarise, an OT analysis has been presented for potential internal CVVC and CVCC syllables in the understudied dialect of Arabic. It has been revealed that avoidance of non-final superheavy CVVC and CVCC syllables is motivated by certain repair strategies: vowel epenthesis and/or onset maximisation. Thus, applying these strategies leads to satisfaction of the top high-ranked constraint *3μ. The violable constraints that represent the former repair strategies, like DEP-V and *[σ CC, are low-ranked to maintain the optimal forms and to keep high-ranked constraints inviolable.

3.6 Summary

This chapter offered a detailed discussion and comprehensive analysis of the syllable structure and syllabification patterns in NNA, with special emphasis given to superheavy syllables. After that, we narrowed the focus down to syllable structure in CA and NNA, an adequate overview was given of syllable inventories and their distribution in both CA followed by NNA. Both CA and NNA ban onsetless syllables. Thus, the markedness constraint ONS is active, which militates against onsetless syllables in the grammar of CA and NNA. On the other hand, codas are optional since open syllables lack codas. Thus, the constraint *CODA is outranked by the ONS. The crucial difference between CA and NNA is that NNA allows both complex onsets and codas, whilst CA allows only complex codas.

It has been demonstrated that syllable weight plays an important role in the typology of syllabification under Moraic Theory. It was observed that the analysis of light CV and heavy CVV, CVC, and CVG syllables is less problematic since the syllabic weight of these syllable shapes are prosodically either monomoraic or bimoraic. Hence, these syllable types respect the undominated constraint *3μ. To clarify, in domain-final position, a CVC is considered as monomoraic because the coda is moraless (weightless) due to the presence of an extrametricality condition. However, in domain-internal position, a CVC is considered as bimoraic because the coda is moraified by the adherence to the constraint WBP. It can be noted that non-final CVC and CVG syllables have similar syllabic weight (bimoraic) since a geminate is always considered to be a moraic segment. The constraint WBP is inviolable in the grammar of NNA except word-finally.

In contrast, superheavy CVVC, CVCC, and CVVG syllables posed a problem for the moraic view because these syllables are prosodically trimoraic. Therefore, there should be an outright violation of the top high-ranked constraint *3μ, whether they occur word-internally or word-finally. Before discussing the syllabic weight of superheavy syllables in NNA, the syllabification patterns of superheavy CVVC and CVCC syllables after suffixation (word internally) in some Arabic dialects were reviewed. In multisyllabic words, CVVG syllables are confined to surface word-internally only, CVCC syllables are confined to surface word-finally, but CVVC syllables freely occur word-internally and word-finally in the dialect.

In domain-final word position, we assumed that potential CVVC and CVCC syllables are bimoraic because the final consonant is treated as extrasyllabic (Hayes 1989). In a non-final superheavy CVVG and CVVC syllables, they are formed only through morpheme concatenation. In CVVG syllables, the first part of a geminate is syllabified as a coda of the first syllable and the second one renders as an onset of the following syllable. To avoid trimoraicity, a mora-sharing approach is invoked where the first leg of a geminate shares a mora with the preceding vowel in order to maintain the bimoraic structure of the syllable (Broselow 1997, Watson 2007, Khattab and Al-Tamimi 2014). In OT terms, the top high-ranked constraint *3μ is inviolable and core constraint in all final and non-final superheavy syllables. That is, in a CVVG syllable, the constraint *****COMPLEX-G should be respected, which allows geminates to be split and surface in heterosyllabic words. What was unusual about superheavy CVVC syllables is that they are allowed to surface not only in a word-final position but also in a word-internal position in derived environments in NNA. Under OT perspectives, it was shown that the interaction between markedness and faithfulness constraints in NNA leads to satisfaction of the core and top high-ranked constraint *3μ. In a word-final position, the undominated constraint WBP is inactive because the low-ranked constraint *FINAL-Cμ is satisfied. In contrast, the WBP constraint is active in a word-internal position in which it is in direct conflict with the low ranked constraint *FINAL-Cμ.

Finally, although NNA allows superheavy CVVC syllables word-internally, it avoids other forms of CVVC through certain repair strategies in derived contexts. These repair strategies can be generalised to avoid superheavy CVCC syllables word-internally. These syllable forms can be prone to vowel epenthesis and/or onset maximisation strategies in order to resolve trimoraic syllables in the surface forms. In OT terms, if vowel epenthesis is applied it means that the faithfulness constraint DEP-V is violated, which in turn leads to satisfaction of the high-ranked constraints in order to meet the maximum syllabic weight requirement in the language. In vowel epenthesis and/or onset maximisation strategies, the violable constraints DEP-V and *[σ CC are low-ranked constraints to obtain the optimal form, leading to respect of the high-ranked constraints, especially the top high-ranked constraint *3μ.

Chapter 4. Consonant Clusters in NNA

4.1 Introduction

The phenomenon of consonant clusters is very common in a large number of languages. These clusters may occur in all word positions in tautosyllabic contexts and word-internally in heterosyllabic contexts. Some languages allow both complex onsets and codas, and others may allow only one of them. On the other hand, some languages may forbid all complex word edges. For example, Classical Arabic (CA) allows coda clusters but not onset clusters. The number of consonants in a cluster is minimally two consonants and maximally it is completely dependent on language-specific restrictions. For instance, English consonant clusters can house up to three consonants word-initially (complex onsets), like /**spr**ɪŋ/ 'spring', and four consonants word-finally (complex codas), like /tɛ**ksts**/ 'texts'. Moreover, the cluster patterns are highly language-specific constraints in which not all segments can form a permitted consonant cluster in a given language. For instance, Japanese does not allow the combination [st] word-initially and word-finally on the surface, and the combinations [kn] and [gn] are prohibited word-initially in Modern English (Crystal 2003).

In this chapter, an attempt is made to introduce the formation of consonant clusters in both tautosyllabic and heterosyllabic words. I examine the permissible and impermissible biconsonantal and triconsonantal clusters in the dialect and investigate the possible restrictions on the occurrence of some consonant clusters. There should be some universal restrictions that block certain clusters to surface in the language. For example, the Sonority Sequencing Principle (SSP) is a cross-linguistic trend and the most popular rule that organises the members of a cluster to form acceptable clusters across languages. Nevertheless, not all languages fully or partially adhere to this principle, as there may be other constraints or phonological processes that affect the occurrence of some consonant clusters or even the permitted segments in a cluster in a language. These constraints and the possible repair strategies will be introduced and couched under the tenets of Optimality Theory (OT) to provide a plausible analysis of the phonological behaviours in the chapter.

The chapter proceeds as follows. Section 4.2 endeavours to demonstrate how complex onset and coda can be structured at either edge of a syllable in tautosyllabic words. The section also provides an overview of how internal biconsonantal and triconsonantal clusters are formed in NNA in heterosyllabic contexts. Section 4.3 investigates the possible restrictions that impact the formation of consonant clusters at a word edge, the coda-onset clusters, and the triconsonantal clusters word-internally. Sections 4.4 and 4.5 introduce the formation of biconsonantal onset and coda clusters in the margins with respect to the SSP and the Minimal Sonority Distance (MSD). Sections 4.6 and 4.7 present forbidden initial and final consonant clusters and the repair strategies utilised to prevent the occurrence of such forms in the dialect. Section 4.8 offers an argument for the effect of the Obligatory Contour Principle (OCP) on the ban of some onset and coda clusters. Section 4.9 provides an overview of the formation of coda-onset clusters and internal -CCC clusters in heterosyllabic words under the control of the Syllable Contact Law (SCL) and any other possible phonological processes. Section 4.10 offers an optimality-theoretic analysis that discusses all the observed phonological behaviours in the chapter. Finally, a conclusion to the chapter is laid out in section 4.11.

4.2 Structure of Consonant Clusters

Generally, complex onsets and codas are permissible in NNA, and they can maximally house up to two consonants[31] in tautosyllabic contexts. Complex onsets occur word-initially as in [**ʤd**a:r] 'wall' and [**gl**o:b] 'hearts', and word-medially as in [ka:.**tb**ah] 'writer (fem.). Coda clusters strictly appear word-finally as in [da**rs**] 'lesson' and [ʤa.la**st**] 'I sat down'. Furthermore, complex onsets and codas can be found in morphologically simple and complex words, and they can be seen at the lexical level or as a result of morpheme concatenation. Consider the following sets of data shown below in (4.1) from NNA introducing complex monomorphemic and bimorphemic onsets:

[31] It should be noted here that complex onsets with more than two consonants are extremely rare in Arabic regional dailects. Nevertheless, in some Levantine varieties, it can be observed that triconsonantal clusters in onset position are permitted in restricted morphological environments; for example, in the masculine singular imperative form [stri:ħ] 'rest' (Mitchell 1993: 60).

(4.1) Complex Onsets Formation

1. Monomorphemic forms:

Underlying form	**Surface form**	**Gloss**
/lθa:m/	[**lθ**a:m]	a face cover
/gma:r/	[**gm**a:r]	gambling
/kta:b/	[**kt**a:b]	book
/ðno:b/	[**ðn**o:b]	sins
/dro:b/	[**dr**o:b]	ways
/ʃʤirah/	[**ʃʤ**i.rah]	tree
/θmirah/	[**θm**i.rah]	gist
/graʕah/	[**gr**a.ʕah]	pumpkin
/mħaku:r/	[**mħ**a.ku:r]	done perfectly
/jhuʤis/	[**jh**u.ʤis]	overthink

2. Bimorphemic forms: (morpheme concatenation: prefixes)

Underlying form	**Surface form**	**Gloss**
/j-ɣamiz/	[**jɣ**a.miz]	he winks at
/j-ħalif/	[**jħ**a.lif]	he swears
/j-ʕadil/	[**jʕ**a.dil]	he treats (someone) fairly
/n-sa:ʕid/	[**ns**a:.ʕid]	we help
/t-ra:ʤiʕ/	[**tr**a:.ʤiʕ]	you (fem. sg.) reviews
/j-sa:fir/	[**js**a:.fir]	he travels
/n-ʕamur/	[**nʕ**a.mur]	we build
/t-ra:gib/	[**tr**a:.gib]	you (fem. sg.) watches

According to the examples in (1), the monomorphemic initial consonant clusters can be seen in a base form as in /gma:r/ ‘gambling’ yielding [**gm**a:r]. The data in (2) show that all initial consonant clusters are bimorphemic forms, which are formed through morpheme concatenation by the attachment of inflectional morphemes to the left or right margins of the word. For example, the stem word is attached to a simple onset forming complex onsets; for instance, /n-sa:ʕid/ ‘we help’ and /j-sa:fir/ ‘he travels’ are realised as [**ns**a:.ʕid] and [**js**a:.fir].

Having briefly introduced the formation of complex onsets, we proceed to the creation of complex codas in NNA. Consider the following examples of coda monomorphemic and bimorphemic clusters listed in (4.2):

(4.2) Complex Coda Formation

1. Monomorphemic forms

Underlying form	**Surface form**	**Gloss**
/ħarb/	[ħa**rb**]	war
/ʕirs/	[ʕi**rs**]	wedding
/mulk/	[mu**lk**]	property
/ħilm/	[ħi**lm**]	dream
/tˤijn/	[tˤi**jn**]	mud

2. Bimorphemic forms: (morpheme concatenation: suffixes)

Underlying form	**Surface form**	**Gloss**
/kitab-t/	[ki.ta**bt**]	I wrote
/ʃarab-t/	[ʃi.ri**bt**]	I drank
/simaʕ-t/	[si.mi**ʕt**]	I heard
/ʔinħabas-t/	[ʔin.ħa.ba**st**/	I got incarcerated
/ʔistaraħ-t/	[ʔis.ta.ra**ħt**]	I got a rest

The data in (4.2) show that complex codas can occur in monomorphemic forms and in bimorphemic forms as a result of morpheme concatenation. The second set of data (2) shows that the formation of coda clusters can be achieved through morphological concatenation, which is limited to one suffix -t in NNA[32].

Moving on to internal biconsonantal -CC- and triconsonantal -CCC- clusters in NNA. Coda-onset clusters are heterosyllabic since they occur in two adjacent syllables within a word or a phrase and confined to non-monomorphemic forms. Triconsonantal -CCC- clusters are not allowed and vowel epenthesis is invoked to split such clusters. Consider the following examples

[32] Other suffixes undergo anaptyxis in NNA like -k, as in the word /walad-k/ surfaces as [wli.d**a**k] 'your son'. This word is pronounced with the final coda cluster in the Attuwair Arabic dialect /walad-k/ surfaces as [wi.la**dk**] (Alhuwaykim 2018: 22).

manifesting the allowable internal biconsonantal -CC- sequences, and the prohibited triconsonantal -CCC- clusters, as shown in (4.3) and (4.4), respectively:

(4.3) Coda-Onset clusters in NNA

Underlying form	**Surface form**	**Gloss**
/ħafl-ah/	[ħa**f.l**ah]	party
/ħidʒrah/	[ħi**dʒ.r**ah]	room
/manzil/	[ma**n.z**il]	house
/na-ʃarħ/	[na**ʃ.r**aħ]	we explain
/ja-liʕb/	[ja**l.ʕ**ab]	he plays
/maktab-uh/	[ma**k.t**i.buh]	his office

(4.4) Internal -CCC- clusters in NNA blockage: vowel epenthesis

Underlying form	**Surface form**	**Gloss**
/ba:ħ-l-kam/	[ba:ħ.l**a**.kam]	he revealed to you (pl.)
/ra:ħ-l-hin/	[ra:ħ.l**a**.hin]	he went to them
/ja-ktb-u:n/	[jak.t**a**.bu:n]	they (mas.) are writing
/ʔiktib-l-hin/	[ʔik.tib.l**i**.hin]	write to them (fem.)!
/ta-ktb-i:n/	[tak.t**a**.bi:n]	you (fem. sg.) are writing

It should be noted from the data in (4.3) that all the coda-onset clusters can be formed by various suffixes. For example, some nouns are attached the vowel-initial suffix -*ah* as in /namil-ah/ ‘ant’ → [na**m.l**ah], or to the vowel-initial -*n*, as in /na-ʃarħ/ → [naʃ.raħ] ‘we explain’. In (4.4), the sequences of internal -CCC- are split by an epenthetic vowel, blocking the occurrence of such clusters in the grammar of NNA. For instance, the underlying form /ʔikti**b**-**l**-**h**in/ ‘write to them (fem.)!’ surfaces as [ʔik.tib.l**i**.hin], whereby the high vowel /i/ is inserted after the second consonant /l/ in order to break up an internal -CCC- cluster.

It is worthwhile mentioning that triconsonantal clusters are not allowed in CA because the vowel insertion process splits such clusters, as in [tak.t**u**.bi:n]. Moreover, in most Arabic varieties, the -CCC- cluster is broken by either inserting a vowel after the first consonant C**v**CC or after the second consonant CC**v**C. For example, in Iraqi Arabic, the word /ja-ksr-un/ 'they (mas.) are breaking' is rendered as [ja.k**i**s.run], where the inserted vowel is placed after the first consonant. On the other hand, in Egyptian Arabic, the same example /ja-ksr-u/ is realised as [jak.s**i**.ru], where the vowel epenthesis is applied after the second consonant to break up the triconsonantal cluster (Al-ghizzi 2006: 9-10).

The next subsections will introduce the possible rules that may influence the formation of consonant clusters in tautosyllabic and heterosyllabic cross-linguistically and more specifically in the investigated dialect.

4.3 Possible Universal Restrictions on Consonant Clusters

Cross-linguistically, the formation of consonant clusters may be impacted by three principles: The Sonority Sequencing Principle (SSP), the Minimal Sonority Distance (MSD), and the Syllable Contact Law (SCL). Subsection 4.3.1 will highlight the main tenets of the SSP with various sonority profiles and how it can affect the occurrence of complex clusters in NNA. Subsection 4.3.2 will account for the MSD's role in determining such clusters in certain languages with some examples. Finally, in subsection 4.3.3, the SCL will be introduced along with its role in heterosyllabic words (coda-onset clusters).

4.3.1 Sonority Sequencing Principle (SSP)

The domain of sonority has been invoked in the syllable and other phonotactic restrictions, such as allowed and disallowed complex onsets and codas in most languages. Ladefoged and Johnson (2011: 245) stated that the "sonority of a sound is its loudness relative to that of other sounds with the same length, stress, and pitch". The concept of sonority was observed as a basis for analysis in a wide range of key works including Vennemann (1972), Hooper (1976), Kiparsky (1979), Selkirk (1984), Zec (1988), Clements (1990), and Blevins (1995). The SSP is defined as a phonotactic principle that aims to arrange the segments of a syllable in a way that conforms to the SSP according to their hierarchic interrelations (Zec 1995). To clarify this definition, the organisation of segments within a syllable is governed by the notion of sonority, a hallmark that classifies segments along a hierarchy from the highest sonorous segments to the least sonorous segments. Consider the following universal sonority scale proposed by Clements

(1990), starting with vowels as the most sonorous segments and terminating with obstruents as the least sonorous segments, as shown in (4.5):

(4.5) Sonority Sequencing Hierarchy

Most Sonorous

1. Vowels
   Low Vowels
   Mid Vowels
   High Vowels
2. Glides
3. Liquids
4. Nasals
5. Obstruents[33]

Least Sonorous

The universal sonority hierarchy can be utilised to categorise the degree of sonority for a segment based on the five natural classes listed above. Thus, this scale will be adopted in the current study. With this intention, the SSP stipulates that every segment has a degree of sonority. The degree of sonority starts moving up progressively from the beginning of the syllable towards the nucleus and then must decrease towards the end of the syllable, resulting in a shape like a mountain or a curve.

Cross-linguistically, the nucleus represents the maximally sonorous segment in a syllable, which can be preceded and/or followed by marginal segments: onsets and/or codas, respectively (Clements 1990: 285). With regard to complex onsets, there is a specified order in which onset clusters abide by the SSP. In most languages, the SSP exhibits a solid universal tendency in which the first consonantal segment has lower sonority than the following consonantal segment in an onset cluster (Selkirk 1984, Clements 1990: 301). With respect to complex codas, the SSP dictates that a closer consonant to the peak should be more sonorous than a consonantal segment

[33] Stops, fricatives, and affricates fall under a single class in the sonority scale which is obstruents (Clements 1990). Nonetheless, some scholars like Selkrik (1984), Katamba (1989), and Butt (1992) have asserted that voiceless obstruents are less sonorous than voiced ones. All in all, in this study, I will follow Clements (1990) who presented the universal sonority scale combining voiced stops, fricatives, and affricates along with voiceless ones under obstruents class as one family.

in the right edge of a syllable. Consequently, the higher sonorous consonant is the consonant nearer the nuclei (Carlisle 2001: 4).

Clements (1990) classified the concept of sonority into three manners: Plateau Sonority, Reverse Sonority, and Falling Sonority. First, Plateau Sonority or (Equal Sonority) occurs when a biconsonantal cluster in a margin has the same degree of sonority in which it disobeys the SSP. This type of sonority can be realised when the two members of a peripheral consonant have a similar degree of sonority, such as the word-initial cluster in NNA containing two obstruents [**ʃdʒ**a.rah] 'tree'. Similarly, this type would be violated with word-final clusters as in the combinations of fricative + fricative coda clusters [na**fs**] 'soul'. Second, Reverse Sonority or (Rising sonority) occurs when edge segments have greater sonority than those closer to the peak. For instance, in CA, an obstruent plus a nasal in coda position as in [fa**χm**] 'luxurious', where the sonority ascends from the first consonant /χ/ and descends toward the second consonant in the right edge of the syllable /m/. In this case, the rising sonority of coda clusters does not fulfill the SSP in CA. However, the previous example is repaired in NNA by a vowel epenthesis strategy to break up the coda cluster, which surfaces as [fa.χ**a**m] to satisfy the SSP. Third, Falling Sonority occurs when the consonantal segment nearer the syllable peak is more sonorous than the second consonant in the left edge of the syllable. This pattern of sonority satisfies the SSP in coda clusters, as opposed to onset clusters which violate the SSP. For instance, a coda cluster obeys the SSP in NNA when it consists of a liquid plus an obstruent as in [da**rs**] 'lesson'. However, an onset cluster violates the SSP in NNA when it consists of a combination of a glide plus an obstruent as in [**jdar**.ris] 'he teaches'.

According to Parker (2011: 1167), when juxtaposed segments violate the SSP, four diverse strategies are cross-linguistically employed to remedy the violation: vowel epenthesis, consonant deletion, syllabic consonants, or metathesis. First, an appropriate vowel is epenthesised to retrieve the unsyllabified consonant, a process known as stray epenthesis (Itô 1986). This process can be found in Serbo-Croatian as in /dobr/ 'good' → [dob**a**r] in which the vowel /a/ is inserted to rescue the /r/ (Kenstowicz 1994). Second, an unlicensed (unsyllabified) consonant is elided to repair SSP violations, a process called stray erasure (Itô 1986). This process is demonstrated in Ancient Greek as in /grap^{h}.**s**t^{h}ai/ 'to have been written' → [gegrap^{h}.t^{h}ai] where the /s/ is omitted because it is a prosodically unparsable segment. Third, the offending consonant is maintained to fix SSP violations. This consonant is deemed phonetically as syllabic. For example, it can be found in English with unstressed sonorant consonants in coda clusters as in pris**m̩**. Fourth and most rarely, SSP violations are resolved by metathesis and a general process of apocope, where a final vowel is omitted as in Western Farsi /suχ**r**(a)/ 'red' → [su**r**χ] (Hock 1985: 534).

Not all languages comply with the SSP when forming such complex margins within syllables, even though there is a robust universal tendency to this principle. For example, in CA, /qabl/ 'before' is realised as [qa**bl**], whereby the coda cluster is formed from the combination of stop +liquid. This combination explicitly violates the SSP due to the first member of the cluster being less sonorous than the second one. Moreover, [st] is a possible word-initial cluster in English, which in turn violates the SSP, where the two segments in the onset position have the same sonority degree (Plateau Sonority) based on the universal scale (DeLisi 2015). It should be noted that the SSP is just one of many factors that influence a language's phonotactics. For example, some Arabic dialects tolerate complex syllable margins in which they can be differentiated by imposing restrictions on their occurrence. More specifically, the rising sonority sequence of complex onset [kl] is more prevalent than the falling sonority sequence [lk], whilst the inverse is true for a word-final consonant cluster (Mustafawi 2017: 33-34).

After introducing the SSP, we should scrutinise other principles that may influence the formation of consonant clusters within the syllable or across syllables, namely, Minimal Sonority Distance and Syllable Contact Law.

4.3.2 Minimal Sonority Distance

It has been observed by some scholars that not all well-formed syllables in a language with respect to the SSP are well-formed in another (Clements 1990: 317). For instance, some complex marginal consonants are disfavoured in certain languages, even though they respect the SSP. To make it clearer, the biconsonantal onset clusters [kn-], [kl-], and [kw-] obey the SSP. However, although a large number of languages allow complex onsets as [kl-] and/or [kw-], consonant clusters like [kn-] are less common. This case can be interpreted as a language-specific requirement in which the members of a complex onset are separated by a minimum distance number of ranks based on the sonority scale presented in 3.6 (Steriade 1982, Selkirk 1984). Hence, /k/ and /l/ are relatively close along this scale and the minimal sonority distance is two steps. Thus, they could be joined as a cluster. Conversely, /k/ and /n/ are very close in the sonority scale in which they are separated by one step, and thus they are not permissible in many languages (Clements 1990). As for the Minimal Sonority Distance (MSD) requirement in some languages, Dutch requires one step distance between the two adjacent consonants in a cluster, whilst Russian tolerates zero steps between the two members of a cluster. As a result, clusters such as [fn] and [sm] are possible in Russian and Dutch. The difference is that Russian also allows [tk] and [mn] as onset clusters too. According to Parker (2011), Hindi and Koluwawa permit onset clusters that contain any combinations of an obstruent plus a glide and a nasal plus a glide, but not an obstruent plus a liquid. These generalisations can be illustrated based on the MSD effect. Another example can manifest the significance of the MSD in Spanish, where biconsonantal onset clusters where the MSD is two steps, such as [**pr**eso] 'prisoner' and [**pl**ano] 'flat' are permitted. However, the onset clusters of [pn-] and [ml-] are not allowed in Spanish, even though these clusters obey the SSP. This case can only be interpreted by invoking and adhering to the MSD parameter in Spanish. Thus, it can be shown that a cluster in Spanish requires a minimal sonority distance of two steps between the first and the second members.

The notion of MSD is a sonority-based principle in which it is considered as a supplement to the SSP depending on the distance between two adjacent segments residing at either edge of the syllable in the sonority scale. Zec (2007: 189) posited a scale to show the MSD for complex onsets, as it is presented in (4.6), where O= obstruents, N= nasals, L= liquids, and G= glides. Zec (2007: 189) summarised the range of values for MSD in the onset position, as laid out in (4.6):

(4.6) MSD Range of Values for Onset Clusters Respecting the SSP

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

It can be noted from (4.6) that the range of values for the MSD is diverse depending on the sonority distance between the members in onset clusters. For example, the MSD-0 indicates that the distance between the two segments of equal sonority is zero steps, such as liquid+ liquid. Furthermore, the MSD can be applied to final-word clusters, too. Thus, a scale of the MSD for code clusters is reversed to the previous scale introduced in (4.6).

4.3.3 Syllable Contact Law (SCL)

Cross-linguistically, the notion of syllable contact is deemed as a constraint that delineates the sonority relation between adjacent consonants across syllable boundaries. This constraint was proposed by Murray and Vennemann (1983) and Vennemann (1988), who stated that sonority must drop across syllable boundaries. Therefore, the coda of a given syllable should be more sonorous than the onset of the following syllable. For instance, [al.ta] is preferred over [at.la] because the sonority falls from /l/ to /t/ but rises from /t/ to /l/. The constraint of SCL is summarised by Davis and Shin (1999), in which they utilise the concept of sonority in (4.7) as follows:

(4.7) Syllable Contact Law (Davis and Shin 1999: 286)

> A syllable contact A.B is the more preferred, the greater the sonority of the offset A and the less the sonority of the onset B.

It should be noted that the universal sonority scale presented in (4.7) is utilised to determine the sonority degree for each segment across syllables. Moreover, this scale can be employed to check the minimal sonority distance between the segments across syllables. Hooper (1976) suggested the SCL for Spanish, where the constraint of the SCL is respected. Based on that, various patterns of coda-onset clusters are acceptable since the sonority of the coda is greater than that of the onset. Hence, it does not matter what the relative sonority distance between the coda and the onset is. For instance, the clusters in heterosyllabic [al.ta] and [al.na] are perfectly acceptable as long as the coda of the initial syllable is more sonorous than the onset in the following syllable. However, the coda-onset sequences [at.la] and [an.la] are undesirable since the onset is more sonorous than the coda. This study assumes that the constraint of the SCL can be adopted to analyse heterosyllabic coda-onset clusters in NNA. In the subsequent sections (4.4) and (4.5), we will discuss the data of complex word edges with various sonority profiles.

4.4 Complex Onset Sonority

Abboud (1979), Al-Mohanna (1998), Kiparsky (2003), Haddad (2005), and Watson (2007) (to name but a few) noted that complex onsets are forbidden in most Arabic varieties including Cairene and Meccan Arabic (cf. Bamakhramah 2009, Aquil 2013). In NNA, initial consonant clusters are permitted and found in word-initial and word-medial positions. As previously stated, complex onsets can host a maximum of two consonants in a syllable. It seems that there are no restrictions to the occurrence of complex onsets with various sonority patterns in this dialect. Thus, a wide range of possible initial consonant clusters is obtained compared to languages that obey the SSP. Now let us examine the NNA data of complex onsets with the three sonority profiles, as listed in (4.8) below:

(4.8) Onset Sonority Patterns

1. **Plateau Sonority** (Equal Sonority):

Cluster Pattern	Underlying form	Surface form	Gloss
Stop – Fricative	/t-ɣars/	[**tɣ**a.ris]	she plants
Stop – Fricative	/bsˤa.lah/	[**bsˤ**a.lah]	onion
Fricative – Stop	/ħba:l/	[**ħb**a:l]	ropes
Affricate – Stop	/ʤda:r/	[**ʤd**a:r]	wall
Fricative – Affricate	/ʃʤi.rah/	[**ʃʤi**.rah]	tree
Fricative –Fricative	/ħsˤa:n/	[**ħsˤ**a:n]	horse
Stop – Stop	/t-ba:.rik/	[**tb**a:.rik]	you (fem. sg.) congratulate
Nasal – Nasal	/m-naðˤ.ðˤam/	[**mn**aðˤ.ðˤam]	organised
Nasal – Nasal	/n-maθ.θil/	[**nm**aθ.θil]	we act
Glide – Glide	/j-wasˤ.sˤiχ/	[**jw**asˤ.sˤiχ]	he messes up

2. **Rising Sonority** (Reverse Sonority):

Obstruent – Nasal	/t-maθ.θil/	[**tm**aθ.θil]	you (fem. sg.) represent
Obstruent – Liquid	/glo:b/	[**gl**o:b]	hearts
Obstruent – Liquid	/zra:.ʕah/	[**zr**a:.ʕah]	agriculture
Obstruent – Liquid	/ʤru:ħ/	[**ʤr**u:ħ]	wounds
Obstruent – Glide	/sˤja:ħ/	[**sˤj**a:ħ]	screaming
Obstruent – Glide	/qja:s/	[**gj**a:s]	measurement
Nasal – Glide	/mwa:fig/	[**mw**a:.fig]	he agrees
Liquid – Glide	/rwa:.jah/	[**rw**a:.jah]	novel

3. Falling Sonority:

Nasal – Obstruent	/n-ʕa:win/	[**nʕ**a:.win]	we help
Nasal – Obstruent	/nʤu:m/	[**nʤu**:m]	stars
Liquid – Obstruent	/lθa:m/	[**lθ**a:m]	face cover
Liquid – Obstruent	/rqubah/	[**rg**u.bah]	neck
Liquid – Nasal	/lmi.sat/	[**lm**i.sat]	she touched
Glide – Obstruent	/j-χasir/	[**jχ**a.sar]	he loses
Glide – Obstruent	/j-da:.ʕib/	[**jd**a:.ʕib]	he tickles
Glide – Fricative	/j-ɣamaz/	[**jɣ**a.miz]	he winks at
Glide – Liquid	/j-raw.wa/	[**jr**aw.wi]	he waters

So far we have fairly attested representative examples of initial consonant clusters; those involving different types of such clusters with various sonority profiles. To be more specific, in (1), complex onsets are formed with a plateau sonority as in [**tb**a:.rik] 'you (fem. sg.) congratulate' and [**jw**asˤ.sˤiχ] 'he messes up', where the two members of the complex onsets contain combinations of Obstruent + Obstruent and Glide + Glide. Hence, both initial peripheral segments have equal sonority based on the sonority scale in which the former and the latter examples do not conform to the SSP.

In (2), initial consonant clusters are formed with rising sonority (Reverse Sonority) based on the universal sonority hierarchy scale, such as [**tm**aθ.θil] 'you (fem. sg.) represent'. This complex onset contains combinations of Obstruent + Nasal in which the first consonants in the cluster are less sonorous than the closer consonants to the peak. Therefore, this type of sonority clearly adheres to the SSP since the second member of the complex onset has higher sonority than the peripheral one.

In (3), complex onsets are formed with a falling sonority, as in [**jχ**a.sar] 'he loses' in which the segment in the left edge is more sonorous than the closer segment to the nucleus. As a result, the former complex onset constitutes combinations of Glide + Obstruent in which these clusters fail to abide by the SSP.

With regard to the minimal sonority distance in all sonority profiles, it can be observed from the data in (1) that the MSD between the two members of complex onsets is strictly zero steps because all the cluster patterns have equal sonority based on the universal sonority scale proposed by Clements (1990). In (2), it can be noted that the possible MSD with rising sonority type is one step between the C1 and C2 in initial consonant clusters. The data of falling sonority in (3) show that the permissible MSD is one step between the two consonants in an onset cluster. Hence, the maximum sonority distance can be up to three steps between members of complex onsets, as in [**jd**aː.ʕib] 'he tickles' in which the first consonant is glide and the second one is stop.

To recapitulate, complex onsets are tolerated in NNA within syllables (tautosyllabic), and they can host up to two consonants. In relation to the rising sonority, this type of sonority always adheres to the SSP and only two phonological phenomena are implemented to form complex onsets. Generally speaking, the production of complex onsets can be affected by certain principles or rules in many languages. This study has examined sets of data with two principles that may affect the formation of complex onsets in NNA, namely, the sonority sequencing principle and the minimal sonority distance. Specifically, three sonority types are attested with complex onsets in order to scrutinise the effectiveness of the SSP when producing such clusters by NNA speakers. It seems that the SSP is not entirely obeyed when forming complex onsets with the three sonority types in NNA. To demonstrate, the SSP is adhered to only with the rising sonority profile, whilst it is violated with the flat and rising sonority profiles. NNA speakers produce complex onset clusters whether these clusters obey or disobey the SSP in all the three sonority profiles because no repair strategy is utilised in order to prevent such clusters. Having established the discussion of onset clusters, the complex coda sonority will be presented and discussed in the next section (4.5).

4.5 Complex Coda Sonority

As mentioned earlier, final consonant clusters are allowed in both CA and NNA. Unlike complex onsets, the creation of final consonant clusters in NNA conforms to the SSP to some extent, whereby the consonants closer to the nucleus should be more sonorous than the consonants in the margin. If a cluster violates the SSP, vowel epenthesis is utilised as a repair strategy to split the final clusters. This remedy strategy can be ascribed to a specific type of sonority and sometimes to certain combinations of a cluster within the same type of sonority. More specifically, complex codas with rising sonority and plateau sonority (only nasal members) violate the SSP in the grammar of NNA. Consider the following set of NNA data involving complex codas with rising sonority as shown in (1) below:

1. **Coda Cluster with Rising Sonority**

Obstruent – Nasal	/ħi**zn**/	[ħi.z**i**n]	sadness
Obstruent – Nasal	/ɣa**bn**/	[ɣab**i**n]	inequity
Obstruent – Nasal	/ħa**sm**/	[ħa.s**i**m]	discount
Obstruent – Nasal	/ɣa**bn**/	[ɣa.b**i**n]	inequity
Obstruent – Liquid	/ga**sˤr**/	[ga.sˤ**i**r]	palace
Obstruent – Liquid	/ʕa**ql**/	[ʕa.g**i**l]	mind
Obstruent – Liquid	/na**ʤl**/	[na.ʤ**i**l]	son
Nasal – Liquid	/ra**ml**/	[ra.m**a**l]	sand

In (1), all the sets of data represent coda clusters with reverse sonority. This type of sonority appears when the peripheral consonant has greater sonority than the consonant nearer to the nucleus. Therefore, these clusters conflict with the SSP since the sonority rises in the coda towards a syllable margin. To cope with this dilemma, NNA speakers insert a vowel to break up such clusters. For instance, the underlying representations /ħi**zn/** ‘sadness’ and /ra**ml**/ ‘sand’ have complex codas with rising sonority, which are proscribed in NNA. However, to solve the violation of the SSP, vowel insertion is applied as a repair strategy to split the final clusters as in their surface forms [ħi.z**i**n] and [ra.m**a**l].

The second type of sonority, which is plateau sonority, will now be mentioned. This type can be classified into two groups: coda nasal clusters and coda obstruent clusters. Generally, plateau sonority disobeys the SSP. However, not all the previous groups fail to abide by the SSP in NNA. To attest the two groups, two sets of data with equal sonority will be introduced to see how they are treated in the dialect: (2a) coda sonorant clusters (only nasal members) and (2b) coda obstruent clusters, respectively:

2a. Coda Cluster with Plateau Sonority (Nasals)

Nasal – Nasal	/sa**mn**/	[sa.m**i**n]	ghee
Nasal – Nasal	/ðˤi**mn**/	[ðˤi.m**i**n]	inclusive
Nasal – Nasal	/ʔa**mn**/	[ʔa.m**i**n]	safety
Nasal – Nasal	/sˤa**nm**[34]/	[sˤa.n**a**m]	idol
Nasal – Nasal	/ɣa**nm**/	[ɣa.n**a**m]	plundering

2b. Coda Cluster with Plateau Sonority (Obstruents)

Cluster Pattern	Underlying form	Surface form	Gloss
Fricative – Fricative	/na**fs**/	[na**fs**]	soul
Fricative – Fricative	/na**sχ**/	[na**sχ**]	copy
Fricative – Stop	/fi**sg**/	[fi**sg**]	depravity
Affricate – Fricative	/ħa**ʤz**/	[ħa**ʤz**]	reservation
Stop – Stop	/zu**bd**/	[zu**bd**]	butter
Stop – Stop	/ħi**qd**/	[ħi**gd**]	animosity
Stop – Fricative	/sa**gf**/	[sa**gf**]	roof

By examining the final coda clusters with plateau sonority in (2a&b), we find that all coda obstruent clusters are permissible except those of nasal+ nasal coda clusters. For instance, the sequences of an affricate plus a fricative that have an equal sonority profile like the underlying form /ħaʤz/ surfaces as [ħaʤz] 'reservation' with no repair strategy, which in turn, violates the

[34] This type of cluster is very rare in NNA and probably in most Arabic varieties compared to the sequence of the coda cluster /nm/.

SSP. However, the sequences of nasals as in the underlying form /samn/ ‘ghee’ surfaces as [sa.min] in which the cluster is split by an epenthetic vowel. The combinations of coda nasal clusters are the only cluster patterns that undergo the vowel epenthesis process with equal sonority. Thus, the SSP is unable to provide a full explanation for this asymmetry. The question arises here why coda nasal clusters with plateau sonority are avoided by an epenthetic vowel but not coda obstruent clusters. Interestingly, the implantation of vowel epenthesis here is not for satisfying the SSP, however, it applies because sonorants require a vowel to their left in the coda and the onset position in the dialect. This assumption has been attested with different examples containing sonorant codas and onsets (either singleton or in clusters) in NNA to ensure that the rule can be generalised to a large extent. Consider the following examples in (2c) below: (note: in this study, I focus only on coda nasal clusters of equal sonority)

(2c) Sonorant Codas and Vowel Epenthesis to Their Left

Sonorant Coda	**Underlying form**	**Surface form**	**Gloss**
/l/	/ħafl/	[ħa.f**i**l]	party
/l/	/nχal/	[naχ**a**l]	palm trees
/l/	/raml/	[ra.m**i**l]	sand
/r/	/ħarf/	/ħ**a**rf]	letter
/r/	/ʕitˤr/	[ʕi.tˤ**i**r]	perfume
/r/	/fagr/	[fag**a**r]	poverty
/m/	/ʃams/	[ʃ**a**ms]	sun
/m/	/faχm/	[fa.χ**a**m]	luxurious
/m/	/ʤism/	[ʤi.s**i**m]	body
/n/	/tibn/	[ti.b**i**n]	hay
/n/	/ɣabn/	[ɣa.b**a**n]	inequity
/n/	/ʔing/	[ʔ**i**ng]	neck

As can be seen from (2c) that all coda sonorants require a vowel to their left in NNA. I assume that such phonological phenomenon needs more consideration which is beyond the purpose of this chapter. More to the point, it should be highlighted that the possibility of extending the analysis of coda sonorant (nasals) clusters to onset sonorant (nasals) clusters is left for future consideration. All in all, it has become clear that not all equal sonority cluster patterns are illicit in the dialect. That is, obstruent coda clusters are allowed, whereas a combination of nasals in the coda position is not allowed in the grammar of NNA.

The third type is falling sonority. Consider the following set of NNA data exemplifying final consonant clusters with falling sonority, as in (3) below:

3. Coda Cluster with Falling Sonority

Nasal – Obstruent	/ʃa**ms**/	[ʃa**ms**]	sun
Nasal – Obstruent	/bi**nt**/	[bi**nt**]	girl
Liquid – Obstruent	/gi**rʃ**/	[gi**rʃ**]	coin
Liquid – Obstruent	/si**lk**/	[si**lk**]	wire
Liquid – Obstruent	/θa**lʤ/**	[θa**lʤ]**	snow
Liquid – Nasal	**/**ʕi**lm/**	[ʕi**lm**]	science
Glide – Obstruent	/sˤa**jd**/	[sˤa**jd**]	hunting
Glide – Nasal	/tˤi**jn/**	[tˤi**jn**]	mud
Glide – Liquid	/ða**jl**/	[ða**jl**]	tail

In (3), all examples display falling sonority between the two members of a coda cluster. These coda clusters occur when the sonority value falls gradually toward the edge of the syllable and the closer consonant to the nucleus holds the greater sonority value. This means that these clusters conform to the SSP. For example, the words [θal**ʤ**] 'snow' and [bi**nt**] 'girl' have combinations of liquid + affricate and nasal + stop in which these right peripheral segments have lower sonority than the preceding consonantal segments. For the case at hand, the adherence of the SSP blocks the occurrence of vowel epenthesis process in NNA.

It can be noted from the data that the MSD is variable in all sonority profiles. To illustrate, the MSD between the first member and the second one in the flat sonority of coda clusters is zero steps. For instance, the combination of stop + stop cluster in the word [zu**bd**] 'butter' and the combination of fricative + fricative cluster, as in [na**s**χ] 'copy', is categorised as obstruent clusters based on the universal sonority scale, hence the MSD is zero steps distance between C1 and C2. Finally, the outputs in (3) exhibit that the MSD is one step between the first and second segments in all coda cluster patterns. For instance, the combination of liquid + nasal in the word [ʕi**lm**] 'science' is one step distance of sonority between the first and second segments in the coda cluster. Hence, NNA permits minimal sonority distance of two and three steps between the C1 and C2, such as [da**rs**] 'lesson' and [tˤi**jn**] 'mud'.

To conclude this section, it is clear that NNA speakers adhere to the SSP when forming the final consonant clusters with all sonority types, except for the obstruent coda clusters in an equal sonority profile. To clarify this point, in plateau sonority, NNA speakers tolerate complex obstruent codas but not with sonorants (nasals) coda clusters. Therefore, NNA speakers only split sonorant clusters in coda position by an epenthetic vowel because sonorant codas require a vowel to their left in NNA, such as with the word /θu**mn**/ 'one-eighth', which is realised as [θu.m**i**n]. Conversely, obstruent clusters are retained as they are in the output forms, such as with the word /ħa**ʤz**/ 'reservation', which surfaces as [ħa**ʤz**]. In terms of a rising sonority profile, it can be seen that none of the examples in (4.12) comply with the SSP since the edge segments have higher sonority than the immediately preceding ones. In NNA, a vowel is inserted to avoid complex syllable margins. For instance, the final consonant cluster in the word /na**ʤl**/ 'son' is pronounced with an epenthetic vowel to split the coda cluster, which renders it as [naʤ**i**l]. The last type of sonority adheres to the SSP because the peripheral consonants have lower sonority value than the preceding ones. That is, the commitment of the SSP deters the appearance of a vowel epenthesis process as a repair strategy in NNA. For instance, in falling sonority, the underlying forms are identical to the surface forms, as in /gi**rʃ**/ 'coin' → [ga**rʃ**]. Regarding the MSD, it can be posited that the complex onsets and codas have similar MSD between the first member and the second one in a cluster. The minimum MSD is zero steps, as found in equal sonority of onset and coda clusters. On the other hand, the maximum sonority distance is three steps in rising and falling sonority of complex onsets and codas.

It is noteworthy to mention at this juncture that not all complex onsets and codas can form a permissible cluster, no matter if these clusters obey or disobey the SSP. Thus, the next two sections will deal with such clusters that are avoided in the grammar of NNA through certain phonological processes. Moreover, these sections will answer the question as to why some of these formations are avoided, other than the SSP restrictions or the requirement of a vowel epenthesis to the left of sonorant codas.

4.6 Forbidden Initial Onset Clusters

We have noted in the previous sections that biconsonantal clusters can be formed monomorphemically and bimorphemically in tautosyllabic contexts with no sonority restrictions. Nevertheless, some consonant cluster patterns are impermissible in NNA due to certain other phonological processes. To clarify, initial consonant clusters can be avoided through two phonological processes: underlying high vowel preservation and gemination. More specifically, regarding forbidden onset cluster patterns the main focus of this study will be on obstruent coronal consonant clusters only, which include stops, fricatives, and affricates. Consider the following cluster patterns shown in (4.9) that are disallowed as initial consonant clusters in the language:

(4.9) Forbidden Initial Onset Clusters

1. Underlying high vowel [i] preservation (monomorphemic forms)

Cluster pattern	**Underlying form**	**Surface form**	**Avoided form**	**Gloss**
Stop – Affricate	/tiʤa:ri/	[t**i**.ʤa:.ri]	*[tʤa:.ri]	commercial
Stop – Affricate	/tiʤa:hal/	[t**i**.ʤa:.hal]	*[tʤa:.hal]	you (mas. sg.) ignore
Stop – Affricate	/diʤa:ʤah/	[d**i**.ʤa:.ʤah]	* [dʤa:.ʤah]	chicken
Affricate – Stop	/ʤidi:d/	[ʤ**i**.di:d]	*[ʤdi:d]	new

The examples in (1) show various types of unauthorised monomorphemic initial consonant clusters in NNA. It can be observed that all onset clusters are avoided in monomorphemic forms through what I have termed ‘underlying high vowel preservation’ for the sake of preventing initial onset clusters from emerging. Essentially, the gemination (assimilation) is not possible here due to the presence of the underlying high vowel /i/, even though it is phonotactically permissible in the language (cf. /t-ʤah:iz/ surfaces as [**ʤ:**ah.hiz] above). Thus, the underlying high vowel /i/ should be maintained in the surface forms to prevent the occurrence of geminates and consonant clusters. This issue is addressed later under the OT account. For example, with the word [ti.ʤa:.hal] ‘ignore’ the deletion of the underlying high vowel /i/ is impossible to ban the combination of onset cluster *[tʤ] to surface in the language because the high vowel /i/ emerges underlyingly. Note that the affricate /ʤ/ is treated as a singleton segment rather than a complex segment in the language because the phoneme /ʒ/ does not exist in the phonemic inventory of NNA.

2. Assimilation (Bimorphemic forms)

Cluster pattern	**Underlying form**	**Surface form**	**Avoided form**	**Gloss**
Stop – Stop	/t-ta:biʕ/	[**t:**a:.biʕ]	*[tta:.biʕ]	you (fem.) follow
Stop – Stop	/t-taʔas:af/	[**t:**a.ʔas.saf]	*[ttʔas.saf]	you (fem.) apologise
Stop – Stop	/t-dar:is/	[**d:**ar.ris]	*[tdar.ris]	you (fem.) teach
Stop – Stop	/t-da:ʕib/	[**d:**a:.ʕib]	*[tida:.ʕib]	you (fem.) tickle
Stop – Stop	/t-tˤa:mir/	[**tˤ:**a:.mir]	*[ttˤa:.mir]	you (fem.) are jumping
Stop – Stop	/t-tˤaʕ:im/	[**tˤ:**aʕ.ʕim]	* ttˤaʕ.ʕim]	you (fem.) get a vaccine
Stop – Affricate	/t-ʤah:iz/	[**ʤ:**ah.hiz]	*[tʤah.hiz]	you (fem.) prepare
Stop – Affricate	/t-ʤar:ib/	[**ʤ:**ar.rib]	*[tʤar.rib]	you (fem.) try
Stop – Fricative	/t-ðˤaħ:i/	[**ðˤ:**aħ.ħi]	*[ti.ðˤaħ.ħi]	you (fem.) sacrifice
Stop – Fricative	/t-ða:.kir/	[**ð:**a:.kir]	*[tða:.kir]	you (fem.) study
Stop – Fricative	/t-θab:it/	[**θ:**ab.bit]	*[tθab.bit]	you (fem.) install
Stop – Fricative	/t-θam:in/	[**θ:**am.min]	*[tθam.min]	you (fem.) appreciate

The data set in (2) displays various types of unauthorised bimorphemic initial consonant clusters in NNA. It should be noted that the morpheme concatenation fails to create potential bimorphemic onset clusters in surface forms when the imperfective tense prefix [t-] ‘you/it (fem., 2nd p.)’ is appended to verbal stems. Meanwhile, the morpheme concatenation and the following consonant attain ideally the environment of creating initial onset clusters in bimorphemic forms. However, NNA appeals to gemination in surface forms to ban onset obstruent clusters, such as the combinations of *[tt], *[td], *[ttˤ], *[tʤ], *[tðˤ], and *[tð], which in turn surface as geminates /t:/, /d:/, /tˤ:/, /ʤ:/, /ðˤ:/, and /ð:/, respectively. The gemination in all examples results from a regressive assimilation in which the prefix [t-] assimilates to the stem-initial consonant. It is worth mentioning that the reverse of initial onset clusters presented earlier, i.e., *[td] → [dt], do not occur underlyingly in both onset and coda positions in the dialect because these forms would undergo gemination. This issue will be tackled in the next section under the discussion on forbidden final consonant clusters.

4.7 Forbidden Final Coda Clusters

It has been observed earlier that complex codas in NNA are mostly governed by the SSP restrictions. Nevertheless, it seems that we have some exceptions in that the obstruent coda clusters in an equal sonority profile are maintained, even though they do not conform with the SSP. It should be mentioned that the same profile of sonority with nasal coda clusters are resolved by the implantation of a vowel epenthesis process as a repair strategy to break up the coda cluster. This repair strategy is implemented to split all the clusters of the rising sonority profile that apparently violate the SSP. This section will shed light on various types of forbidden monomorphemic and bimorphemic coda clusters and on the possible phonological processes that have been utilised to avoid such clusters other than the SSP. Consider the following data in (4.10) showing the prohibited bimorphemic final coda clusters in the dialect:

(4.10) Forbidden Final Coda Clusters

1. Gemination (Bimorphemic forms)

Cluster pattern	Underlying form	Surface form	Avoided form	Gloss
Stop – Stop	/sˤaʕad-t/	[sˤa.ʕa**d:**[35]]	*[sˤa.ʕadt]/ *[sˤa.ʕa.dit]	I escalated
Stop – Stop	/maʕatˤ-t/	[ma.ʕa**tˤ:**]	*[ma.ʕatˤt]/ *[ma.ʕa.tˤit]	I tore out
Stop – Stop	/mad:ad-t/	[mad.da**d:**]	*[mad.dadt]/ *[mad.da.dit]	I extended
Stop – Stop	/sakat-t/	[sa.ka**t:**]	*[si.ka.tit]	I kept silent
Fricative – Stop	/faraðˤ-t/	[fa.ra**ðˤ:**]	*[fa.raðˤt]/ *[fa.ra.ðˤit]	I imposed
Fricative – Stop	/ʔaχað-t/	[ʔa.χa**ð:**]	*[ʔa.χaðt]/ *[ʔa.χa.ðit]	I took
Fricative – Stop	/waraθ-t/	[wa.ra**θ:**]	*[wa.raθt]/ *[wa.ra.θit]	I inherited

The data in (4.10) exhibit the second type of forbidden final coda clusters in NNA. It is notable that all the words are suffixed by the verbal -t 'you', which is attached to the identical or near identical stem-final consonant. To clarify, the stem-final consonant can be either a stop or a fricative. The sequences *[dt], *[tˤt], and *[ðt] undergo gemination in these bimorphemic forms. The gemination, as a repair strategy, deprives such clusters to create a well-formed consonant cluster in the right edge. Furthermore, all the bimorphemic forms emanate from a progressive assimilation, as opposed to prohibited onset clusters, in which the suffix -t assimilates to the stem-final consonants. For example, the biconsonantal coda clusters *[tt] and *[dt], as in /sikat-

[35] All geminates in the surface forms are considered as fake geminates. These forms result from progressive assimilation. Fake geminates are homogenous consonants that may accidentally emerge across morpheme or word/phrase boundaries.

t/ 'I kept silent' and /sˤa.ʕad-t/ 'I escalated', are geminated in the surface forms as [si.ka**t:**] and [sˤa.ʕa**d:**] in order to ban final coda clusters.

To conclude these two sections, we demonstrated that not all tautosyllabic onset and coda consonant clusters are allowed in NNA. Some combinations of onset and coda clusters are not tolerated in the dialect through certain repair strategies. To illustrate, underlying high vowel preservation and vowel epenthesis are possible repair strategies to avoid forming onset clusters with monomorphemic and bimorphemic forms. Worthy of note is that the repair strategy of gemination has been implemented with bimorphemic forms only in both the prohibited onset and coda consonant clusters. Moreover, we can observe that the regressive assimilation process targets the prefix in an onset cluster, whilst the progressive assimilation process targets the suffix in a coda cluster. NNA prefers to maintain stem consonants in both onset and coda clusters. In this chapter, it should be mentioned here that I will only cover the coronal obstruents in both onset and coda clusters as well as anterior sonorants in coda clusters. In the subsequent section, I will discuss the effect of the Obligatory Contour Principle (OCP) on some of the prohibited word edge clusters in question.

4.8 Obligatory Contour Principle (OCP)

It can be observed from the data in (4.9) and (4.10) that the ban of some word edge clusters cannot be interpreted due to the limitations imposed by the SSP only. That is, some peripheral consonant clusters violate the SSP; however, they are still allowed to surface in the dialect, such as the onset cluster of falling sonority [**md**ar.ris] 'teacher' and the coda cluster of plateau sonority [fi**sg**] 'depravity'. At first glance, if we look at the prohibited consonant clusters in both data sets, we may notice that all the members of clusters are coronal obstruents in both word edge clusters. To account for such specifications, the primary analysis is that the dialect has co-occurrence restrictions governed by the OCP, which in turn blocks these two consecutive or adjacent identical consonants in a cluster to surface at either edge of the syllable. Consequently, I argue that the Obligatory Contour Principle (OCP) (Leben 1973, McCarthy 1986, Odden 1986), which forbids identical adjacent feature specifications, is active in the grammar of NNA as found in cross-dialectal variations of Arabic. This principle has been defined by Leben (1973) and formulated in (4.11) as follows:

(4.11) Obligatory Contour Principle (OCP)

At the melodic level, adjacent identical elements are prohibited.

This principle has emerged from autosegmental phonology and constantly remained the subject of some debate (Kenstowicz 1994). Cross-linguistically, the OCP is invoked as an interpretation of the prohibition of any homogenous features, tones, and segments. With respect to Arabic, it can be plausibly noted that the OCP has a robust impact on the analysis of adjacent identical segments that share similar specifications in consonantal roots and hence it is an active constraint in the language (McCarthy 1986). According to Frisch *et al.* (2004), OCP-Place, a constraint that formally bans two segments that share identical place specifications, is not absolute but gradient in Arabic. To explain, 'a gradient constraint is a constraint that is quantitatively sensitive to violations of different degrees, such that forms that violate the constraint to a lesser degree are more frequent than forms that violate the constraint to a greater degree' (Frisch *et al.* 2004: 182). It can be observed that the more features are shared between two adjacent consonants, the more it results in stronger implementation of the OCP restriction on their co-occurrence in a given language. Also, Frisch *et al.* (2004) pointed out that the distance between two consonants plays a vital role in the OCP in which this constraint is more active on adjacent consonants compared to non-adjacent ones. Frisch and Zawaydeh (2001) ran a psycholinguistic experiment and argued that the OCP-Place has a synchronic physiological impact on the grammar of Arabic native speakers. Accordingly, they observed that Jordanian Arabic speakers declined novel words that consist of identical consonants violating the OCP-Place as compared to novel words that do not violate the same constraint. Most prior studies have demonstrated the effect of the OCP within root forms. However, at the morpheme boundary level, the effect of the OCP in the bimorphemic environment is rather less studied (see Alahmari 2018).

Looking again at the data in (4.9) and (4.10) above, I posit that the forbidden clusters presented earlier share the major place feature [coronal]. Therefore, I assume that the effect of the constraint OCP [cor] militates against consonants that share the place specification [+cor] in the dialect. However, this constraint itself is inadequate to account for the prohibition imposed on obstruent clusters since not all obstruents are coronals. I argue that the effect of the constraint OCP manner feature [-continuant] is responsible for the illicit obstruent clusters from occurring in adjacency. Therefore, the constraint OCP[-cont] can refine the coronal obstruents among others, which illustrates the reason why these clusters are avoided in NNA. To this end, obstruent clusters that share the major place specification [+cor] and the manner specification [-cont] are prohibited from occurring in adjacency. Under these assumptions, Morelli (1999) educed the constraint OCP[-cont] for tautosyllabic words and it has been modified by Alahmari

(2018) to fit with coronal obstruent clusters, which are banned from being adjacent to one another in a word edge cluster. This constraint is expressed in (4.12) as follows:

(4.12) OCP-Cor[-son][-cont] (Morelli 1999)

Tautosyllabic [-continuant] coronal obstruents are disallowed.

The constraint in (4.12) meets the requirements of the prohibited coronal obstruent clusters in NNA, such as *[tʤ], *[dʤ], *[tt], *[td], and * [ttˤ]. It should be noted here that these clusters contain combinations of either a stop followed by an affricate, or a stop followed by a stop, but not fricatives. In contrast, some onset clusters seem to be quite problematic under the OCP rule in (4.12) because they share the same features, but they still surface in the dialect. Consider the following examples in (4.13):

(4.13) Allowed Monomorphemic Consonant Clusters

Cluster pattern	**Underlying form**	**Surface form**	**Gloss**
[ʤd]	/ʤda:r/	[ʤda:r]	wall
[ʤd]	/ʤdu:d/	[ʤdu:d]	ancestors

As can be observed from the examples in (4.13), the onset cluster [ʤd] is permitted in the grammar of NNA. This onset cluster goes against the OCP rule in (4.12), which treats stops and affricates for the manner feature as [-cont], whilst fricatives as [+cont]. Based on this analysis, the onset cluster [ʤd] should never surface in the dialect because the OCP[-cont] is active. To obviate such restrictions, we should treat [ʤ] as two separate segments when it comes to the OCP approach in which affricates show edge effects. Hence, the left edge of the affricate [ʤ] is treated as a stop [d], whilst the right edge as a fricative [ʒ]. To wind up, I assume that affricates are analysed under two different manner specifications, a stop as [-cont] and a fricative as [+cont]. Consequently, a cluster of a stop plus an affricate is not tolerated, while an affricate plus a stop is allowed in which the contradiction in (4.12) is resolved (cf. Alhuwaykim 2018).

Taking a closer look at the data in (4.9) and (4.10), we notice that the constraint OCP-Cor[-son][-cont] does not account for fricatives since it is confined to stops and affricates. This constraint fails to adequately account for the ban on clusters like *[tðˤ], *[tθ], and *[tð], where the sequences of a stop plus a fricative have contrasted values for the manner feature [continuant], (i.e., a stop [-cont] followed by a fricative [+cont]). As a result, we should come up with another constraint in order to include the fricatives *[tθ], *[tð], and *[tðˤ]. Before doing that, I will provide sequences of stop + fricative onset and coda clusters to examine how the OCP constraint functions in the dialect, as shown in (4.14) below:

(4.14) Sequences of Stops + Fricatives

1. Allowed Bimorphemic Complex Word Edges

Cluster pattern	**Underlying form**	**Surface form**	**Avoided form**	**Gloss**
[ts]	/t-sa:miħ/	[**ts**a:.miħ]	*[s:a:.miħ]	you (fem.) forgive
[st]	/ʤalas-t/	[ʤa.la**st**]	*[ʤa.las:]/ *[ʤa.lasi]	I sat down
[tz]	/t-zaw:ir/	[**tz**aw.wir]	*[z:aw:r]	you (fem.) forge
[zt]	/ħaʤaz-t/	[ħa.ʤa**zt**]	*[ħaʤaz:]/*[ħaʤazit]	I booked
[tʃ]	/t-ʃaʤ:iʕ/	[**tʃ**aʤ.ʤiʕ]	*[ʃ:aʤ.ʤiʕ]	you (fem.) support
[tʃ]	/tˤifiʃ-t/	[tˤi.fi**ʃt**]	*[tˤi.fiʃt]/ *[tˤi.fi.ʃit]	I got bored

2. Disallowed Bimorphemic Complex Word Edges

Cluster pattern	Underlying form	Surface form	Avoided form	Gloss
*[tðˤ]	/t-ðˤaχ:im/	[**ðˤ:**aχ.χim]	*[tðˤaχ:im]	you (sg.) expand
*[ðˤt]	/faraðˤ-t/	[fara**ðˤ:**]	*[faraðˤt]	I imposed
*[tθ]	/t-θab:it/	[**θ:**ab.bit]	* [tθabit]	you (sg.) tie up
*[θt]	/wiriθ-t/	[wi.ri**θ:**]	*[wi.riθt]	I inherited
*[tð]	/t-ðu:g/	[**ð:**u:g]	*[tðu:g]	you (sg.) taste
*[ðt]	/ʔaχað-t/	[ʔa.χa**ð:**]	*[ʔaχaðt]	I took

The examples in (1) denote that fricatives behave differently in the dialect. The sequences of [ts], [tf], [tz], and [tʃ], and their mirror image clusters can clearly form complex onsets and codas. On the other hand, the sequences of [tðˤ], [tθ], and [tð], and their mirror image coda clusters are banned from creating a well-formed onset and coda consonant cluster and are avoided via gemination (assimilation). Thus, the constraint in (4.12) is unable to illustrate why these clusters are allowed to surface in (4.13) and (4.14/1), while those in (4.14/2) are not allowed since stops are identified for the manner specification [-cont] and fricatives are identified for the manner specification [+cont]. This discrepancy should be resolved in order to obtain a unified constraint that includes all forbidden stop plus fricative clusters presented in (4.14/2). If we go back to the allowed clusters presented in (4.14/1), we find that the stops [t] and [d] are specified for the manner feature [-strident] and coronal fricatives are specified for the manner feature [+strident]. On the other hand, all the disallowed clusters in (4.14/2) are specified for the manner feature [-strident]. Consequently, we can infer that the constraint OCP blocks the co-occurrence of the coronal stop [t] with a coronal fricative at the left margins of tautosyllabic words when the stop and the fricative share the same major manner feature [-strident]. Now, we might bring up a new proposed OCP constraint that requires coronal obstruents to contradict with the value of the manner feature [strident]. Therefore, the co-occurrence of coronal obstruents that share the same manner feature [-strident] prohibits the formation of tolerated onset and coda clusters in the dialect. The OCP constraint can be formulated as shown in (4.15) below:

(4.15) OCP-Cor[-son][-strid]

Tautosyllabic [-strident] coronal obstruents are disallowed.

The constraint in (4.15) covers all the prohibited coronal obstruent clusters in NNA presented in (4.14/2), such as *[tðˤ], *[ðˤt], *[tθ], *[θt], *[tð], and *[ðt].

To sum up, the SSP cannot completely explain the reason why some clusters are prohibited in the margins as some of them still occur in the dialect. It can be noted that the OCP constraint is responsible for the ban on some impermissible tautosyllabic word edge clusters in the language. Thus, three OCP constraints are proposed that militate against the co-occurrence of forbidden onset and coda coronal obstruent and sonorant nasal clusters. Two OCP constraints represent the prohibition on onset obstruent clusters, which includes a combination of an affricate and a stop. The first constraint covers some coronal obstruent clusters, specifically, *[tʤ], *[dʤ], *[tt], *[td], and * [ttˤ], as stated in (4.12). The second constraint involves sequences of a stop plus a fricative [tðˤ], [tθ], and [tð], as stated in (4.15).

Having introduced the formation of tautosyllabic onset and coda consonant clusters and the possible restrictions on the occurrence of some consonant clusters and the undesirable edge clusters in NNA, now let us discuss the heterosyllabic coda-onset cluster and internal -CCC- clusters in the next section and its subsections.

4.9 Heterosyllabic Consonant Clusters

In tautosyllabic clusters, languages commonly favour a rise in sonority within an initial consonant cluster and a descent within a final consonant cluster (Ohala 1990). In heterosyllabic clusters, however, coda-onset clusters are linked with the notion of the SCL, which stipulates that a coda-onset cluster prefers falling sonority profile cross syllables. That is, the coda of an initial syllable should be more sonorous than the onset of the following syllable. For example, the sequence [al.ka] with falling sonority is favoured over [ak.la] with rising sonority. As noted in the literature, such clusters that do not meet the criteria of the SCL are more likely to be prone to certain repair strategies[36], such as vowel deletion, metathesis, gemination, and vowel epenthesis, in order to improve the satisfaction of the SCL (Hall 2006: 21-22).

With regard to the -CCC- sequence, it seems that NNA does not allow medial -CCC- clusters. This type of cluster is not allowed in many other Arabic varieties whereby such clusters are split by a vowel epenthesis either after the first consonant CvCC or after the second consonant CCvC. The next two subsections will examine the SCL with some examples involving coda-onset clusters. Thereafter, the realisation of internal -CCC- clusters in NNA will be presented along with the phonological processes that may hinder the occurrence of such clusters.

4.9.1 Coda-Onset Clusters

It can be seen from the data in (4.16) below that all the outputs are well-formed syllables in NNA, although they disobey the SCL in some situations. This follows the SCL, which requires that a syllable boundary should contain falling sonority; that is, the examples that have coda-onset sequences with flat or rising sonority profiles violate the SCL but still surface in the language. For example, the words [mi**f**.**t**a:ħ] 'key' and [na**ħ**.**l**ah] 'bee' entail combinations of fricative + stop and fricative + liquid. The coda-onset sequence of [f.t] shows an internal cluster of equal sonority, whilst the coda-onset sequence of [ħ.l] shows an internal cluster of rising sonority. On the other hand, the outputs with falling sonority are equally acceptable based on the SCL constraint. For instance, the words [ta**n**.**ʤ**i:d] 'upholstery' and [ʤi**j**.**b**uh] 'his pocket' adhere to the SCL whereby the sonority declines toward the onsets of the second syllable.

Furthermore, it is clear that the MSD is zero steps with equal sonority as in [ja**b**.**ts**ij] 'he is crying', where the stop and affricate cluster falls under an obstruent family based on the universal sonority scale . With rising sonority, the MSD is one step as in stop plus nasal cluster [ka**d**.**m**ah] 'bruise', and up to three steps as in stop plus glide [fi**d**.**j**ah] 'ransom'. It can be observed that the MSD is one step between the coda-onset cluster as in nasal plus fricative

[36] According to Gouskova (2004), Sidamo, An Afro-Asiatic language, follows the constraint SCL in which rising sonority over a syllable boundary is not allowed. However, falling sonority by two sonority steps is required. In order to satisfy the SCL, rising sonority across two syllables is repaired by metathesis. For instance, the word /hutʃ.nanni/ 'they pray' is realised as [hun.tʃanni] where the cluster in the underlying form [tʃn] is reversed to [ntʃ] in the surface form to satisfy the SCL. In Korean, a cluster of rising sonority with certain segments across two syllables is avoided via gemination. To illustrate, when the onset of the second syllable is liquid /l/ preceded by a coronal nasal, lateralisation takes place causing a germinate /l/ such as /non-li/ 'logic' yielding [nol.li] to satisfy the SCL.

[ma**n**.**h**adʒ] 'curriculum/method', and up to three steps as in glide plus stop [dʒi**j**.**b**uh] 'his pocket'. Consider the data of coda-onset clusters presented in (4.16):

(4.16) Coda-Onset Clusters and Sonority Patterns

Cluster pattern	**Underlying form**	**Surface form**	**Gloss**
Stop – Affricate	/jab.kij/	[ja**b**.**ts**ij]	he is crying
Stop – Affricate	/mat.ħaf/	[ma**t**.**ħ**af]	museum
Fricative – Stop	/mif.ta:ħ/	[mi**f**.**t**a:ħ]	key
Fricative – Liquid	/naħ.lah/	[na**ħ**.**l**ah]	bee
Liquid – Fricative	/jar.fiðˤ/	/ja**r**.**f**iðˤ/	refuse
Glide – Liquid	/χaj.ra:t/	[χi**j**.**r**a:t]	welfare
Nasal – Fricative	/man.hadʒ/	[ma**n**.**h**adʒ]	curriculum/method
Stop – Glide	/fid.jah/	[fi**d**.**j**ah]	ransom
Glide – Stop	/dʒij.buh/	[dʒi**j**.**b**uh]	his pocket
Stop – Nasal	/kad.mah/	[ka**d**.**m**ah]	bruise
Nasal – Affricate	/tan.dʒi:d/	[ta**n**.**dʒ**i:d]	upholstery

4.9.2 *Internal -CCC- Clusters*

Like many contemporary Arabic vernaculars [37], NNA disallows a medial -CCC- sequence in derived environments[38]. That is, internal -CCC- clusters are impermissible due to the vowel insertion process, which splits such clusters; for example, /ʃuf-t-kam/ ‘I saw you (mas.)’ becomes [ʃuf.ta.kam]. The following data shown in (4.17) below exemplify the ban on the creation of internal -CCC- clusters in NNA:

(4.17) Internal -CCC- Clusters blockage by high vowel epenthesis

Underlying form	**Surface form**	**Gloss**
/ba:**ħ-l-k**am/	[ba:ħ.l**a**.kam]	he revealed to you
/ʔiktu**b-l-h**in/	[ʔik.tub.l**i**.hin]	write to them (fem.)!
/ta-**katb**-i:n/	[tak.t**a**.bi:n]	you (fem. sg.) writing
/ja-**rsm**-u:n/	[jar.s**a**.mu:n]	they (mas. pl.) drawing
/masak-l-ham/	[ma.sak.l**a**.ham]	he caught for them

In (4.17) it can be noted that all NNA data involve medial -CCC- clusters in the underlying representations. For the purpose of preventing such clusters to surface, a vowel is epenthesised after the second consonants in order to break up the medial -CCC- sequence. For instance, the underlying form /ʔikti**b-l-h**in/ ‘write to them (fem.)!’ surfaces as [ʔik.tub.l**i**.hin] and /ja-rsm-

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[37] Itô (1989: 240-243) stated that Cairene and Iraqi Arabic do not tolerate a medial -CCC- cluster. These dialects utilise vowel epenthesis to break up such clusters. The site of epenthesis is considered language-specific. The vowel could appear before or after the second consonant. For example, in Cairene Arabic, the vowel is epenthesised after the second consonant in a triconsonantal cluster as in /ʔul-t-l-u/ ‘I said to him’ renders as [ʔul.t**i**.lu], while Iraqi Arabic inserts an epenthetic vowel before the second consonant as in /gil-t-l-a/ ‘I said to him’ renders as [gi.l**i**t.la].

[38] It should be noted that some words like [gil.tluh] ‘I said to her’ and [riħ.tlah] ‘I went to her’ occur with internal -CCC- clusters in the dialect. This uncommon case is occurred only when a verb plus the consonant-initial subject suffix /t/ is suffixed with the dative /l/ and followed by one of the object suffixes: a vowel-initial or a consonant-initial object suffix. Otherwise, internal -CCC- clusters are not allowed in the dialect. In OT terms, this exceptional situation will not affect the general ranking of the constraint *-CCC- as undominated in which it outranks the vowel epenthesis constraint DEP-V in the grammar of NNA.

u:n/ ‘they (mas. pl.) drawing’ surfaces as [jar.s**a**.mu:n], whereby a vowel is epenthesised after the second consonants /l/ and /s/ to split the triconsonantal clusters.

To wind up this subsection, a consonant cluster that spans different syllables is referred to technically as heterosyllabic. As presented in sections 4.3.3 and 4.9, coda-onset clusters are associated with the concept of the SCL, which favours a falling sonority type. The outputs show that the heterosyllabic clusters in NNA violate the SCL with equal and rising sonority, but they obey the SCL with falling sonority. Thus, no repair strategies seem to be employed to avoid the violation of the SCL. Regarding the MSD, it can be noted that the MDS is zero steps between the members with equal sonority, whilst it is one step with rising and falling sonority. A medial -CCC- cluster is prone to vowel epenthesis to disallow such clusters to surface in the language.

In the next section, by implementing the framework of Optimality Theory, I will employ some constraints to formally account for general observations regarding the formation of complex word edges, the restrictions on the occurrence of some prohibited edge clusters, specifically the effect of the OCP constraint and the repair strategies implemented to prevent such clusters in tautosyllabic contexts. Also, I will account for the effects of the SSP, the MSD, and the SCL in the formation of the coda-onset clusters, and finally the ban on the formation of internal -CCC- clusters in heterosyllabic contexts in NNA.

4.10 Optimality-Theoretic Analysis

We have already seen that consonant clusters are permissible in tautosyllabic contexts in NNA. Nevertheless, some types of marginal clusters are forbidden. With regard to tautosyllabic consonant clusters, complex onsets can be formed monomorphemically and bimorphemically as a result of morpheme concatenation in the language. Also, they can be formed as a result of the high vowel syncope in bimorphemic forms when they occur in a word-final position. In final consonant clusters, they are formed monomorphemically and bimorphemically as a result of morpheme concatenation, which is confined to one suffix -t ‘you’ in NNA. In the context of heterosyllabic consonant clusters, we have seen two types of consonant clusters: a coda-onset cluster and a medial triconsonantal cluster. In a coda-onset cluster, it should be noted that the notion of the SCL is not satisfied in the grammar of NNA when only forming rising sonority heterosyllabic clusters. The last type of consonant cluster is internal -CCC- sequences. These clusters are forbidden and repaired via vowel epenthesis after the second consonant to break up such clusters in the dialect. The goal of this section is to develop an Optimality Theory (OT) analysis to capture such generalisations about consonant clusters in tautosyllabic and heterosyllabic words.

In the following subsections, I will account for monomorphemic and bimorphemic complex onset forms followed by the illicit complex onsets in both forms. After that, the relationship between complex codas and the Sonority Sequencing Principle will be highlighted, followed by the prohibited coda clusters in monomorphemic and bimorphemic forms in the language. Then, I will account for the formation of coda-onset clusters with respect to the SCL. Finally, I will discuss the phonological process that triggers the ban on internal -CCC- sequences in the language.

4.10.1 Monomorphemic and Bimorphemic Initial Consonant Clusters

Unlike CA and many Arabic dialects, NNA permits complex onsets with all sonority profiles: plateau, rising, and falling. In OT perspectives, since biconsonantal onset clusters are tolerated in the language, the faithfulness constraint DEP-V is ranked above the markedness constraint *[σ CC. The constraint *[σ CC has already been defined in Chapter Three and it is repeated in (4.18) below for convenience:

(4.18) *COMPLEX^{ONS} *[σ CC (Kager 1999)

Onsets are simple.

The constraint in (4.18) penalises any biconsonantal onset clusters. It is apparently in direct conflict with the faithfulness constraint DEP-V, which bans vowel epenthesis, splitting a potential onset consonant cluster. Since complex onsets are allowed in the language, the violable constraint *[σ CC should be low-ranked in order to obtain the optimal form. The constraint DEP-V has already been adopted in Chapter Three and it is repeated in (4.19) below for convenience:

(4.19) DEP-V (McCarthy and Prince 1995)

Output vowels must have input correspondents.

It should be mentioned here that the creation of complex onsets with all sonority profiles is not sensitive to the SSP because no repair strategies are applied when a potential complex onset violates the SSP rule. Now, let us see the interaction between the markedness constraint *[σ CC and the faithfulness constraint DEP-V in order to obtain the correct initial complex onset form, as shown in tableau (4.20) below:

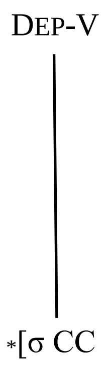
(4.20) /ħsˤa:n/ → [ħsˤa:n] ‘horse’

/ħsˤa:n/	DEP-V	*[σ CC
a. ☞ [ħsˤa:n]		*
b. [ħi.sˤa:n]	*!	

It is clear from the tableau above that the faithful candidate (a) surfaces as the optimal from because it respects the constraint DEP-V at the expense of violating the dominated constraint *[σ CC. Candidate (b) forfeits optimality due to the violation of the undominated constraint DEP-V that penalises vowel epenthesis.

The general constraint ranking proposed so far for tolerated initial biconsonantal clusters in monomorphemic and bimorphemic is summarised in the following Hasse diagram, as is shown in (4.21):

(4.21) Summary constraint ranking for allowable onset clusters



Although biconsonantal onset clusters are permitted in NNA, some initial onset clusters in monomorphemic and bimorphemic forms are prohibited from surfacing due to restrictions imposed by some phonological processes. The next subsection will offer an OT analysis of the prohibited complex onsets in the language.

4.10.2 Forbidden Initial Consonant Clusters

We have observed that the SSP plays no role in forming monomorphemic onset biconsonantal clusters in tautosyllabic contexts in NNA. Yet, some complex onsets are not tolerated due to certain phonological processes, namely, the preservation of the underlying high vowel /i/, gemination (assimilation), and vowel epenthesis. These phonological processes are invoked due to the restriction imposed by the OCP. In the current study, the preservation of the underlying high vowel /i/ is limited to monomorphemic onset cluster forms, whereas gemination and vowel epenthesis are limited to bimorphemic onset cluster forms. These phonological processes prevent the creation of complex onsets, which will be discussed within the OT, respectively. As mentioned earlier, the onset cluster patterns in question involve only the obstruent consonant clusters. In the next subsection, I will begin with the illicit monomorphemic complex onset forms which are resolved by the preservation of an underlying high vowel /i/ in order to prevent their occurrence.

1. **Forbidden Monomorphemic Complex Onsets**

As mentioned previously, the preservation of the high vowel /i/ is confined to monomorphemic onset clusters in the language. This phonological process is implemented in order to disallow monomorphemic onset clusters to surface in the language due to OCP restrictions. This phonological process can be translated into an OT constraint, as proposed by Kenstowicz (1996) and defined in (4.22) below:

(4.22) *i]σ

High short unstressed vowels in open syllables are not allowed.

The constraint *i]σ is assumed to militate against the high vowel /i/ in open syllables. The violation of the markedness constraint *i]σ causes unfaithful mapping between an input and an output. However, obeying this constraint leads to violation of the faithfulness constraint MAX-V (Kager 1999), which requires output vowel(s) to be fulfilled in an input. This constraint is defined in (4.23) below:

(4.23) MAX-V

Input vowels must have output correspondents.

In OT perspectives, we will recall the previous constraints and check if they are adequate to account for prohibited monomorphemic complex onsets that result from underlying high vowel preservation, such as /ʤidi:d/ 'new', which surfaces as [ʤi.di:d]'. This can be seen in the following tableau (4.24), which evaluates the input /diʤa:ʤah/ 'chicken':

(4.24) /diʤa:ʤah/ → [di.ʤa:.ʤah] 'chicken'

/diʤa:ʤah/	*i]σ	MAX-V	*[σ CC
a. [di.ʤa:.ʤah]	*!		
b. 💣[dʤa:.ʤah]		*	*

It is obvious from the tableau that the optimal form (b) is selected incorrectly. However, the actual optimal form loses due to violation of the undominated constraint *i]σ. Thus, the current constraint ranking is inappropriate to account for the forbidden complex onsets in monomorphemic forms. In order to evaluate this type of illicit complex onsets, we should adopt a constraint that dominates the constraint *i]σ for the sake of eliminating candidate (b) and assists us in identifying candidate (a) as the winner form. To achieve this, I assume that the OCP constraint OCP-Cor[-son][-cont], presented earlier in (4.12), plays a crucial role in excluding any potential candidate with prohibited coronal obstruent of onset clusters, in particular, a combination of a stop followed by an affricate or a stop followed by a stop. In OT terms, the OCP constraint OCP-Cor[-son][-cont] is introduced in (4.25) below:

(4.25) OCP-Cor[-son][-cont] (Morelli 1999)

> Assign one violation for any two consonants with the features [+Cor, -Cont] which are adjacent in an onset.

To better understand how this constraint interacts with other faithfulness constraints, consider the following tableau (4.26), which evaluates the same input /diʤa:ʤah/ 'chicken':

(4.26) /didʒa:dʒah/ → [di.dʒa:.dʒah] 'chicken'

/didʒa:dʒah/	OCP-Cor [-son][-cont]	MAX-C	*i]σ	MAX-V	*[σ CC
a. ☞ [di.dʒa:.dʒah]			*		
b. [ddʒa:.dʒah]	*!			*	*
c. [dʒa:.dʒah]		*!		*	

The constraint OCP-Cor[-son][-cont] scans both candidates and selects the faithful candidate (a) as the optimal form correctly, which preserves the underlying high vowel [i] in the surface form. Candidate (b) satisfies the constraint *i]σ, allowing the complex onset to surface, which in turn leads to serious violation of the high-ranked constraint OCP-Cor[-son][-cont]. Consequently, this candidate is ruled out of the competition. Finally, candidate (c) violates one undominated constraint by deleting one consonant and one dominated constraint by deleting one vowel.

Another potential strategy is assimilation creating a geminate consonant. This strategy seems to be utilised in order to avoid forbidden onset clusters due to the OCP effect only in bimorphemic forms. To clarify, gemination derives from a regressive assimilation in which the prefix [t] assimilates to the stem-initial consonant whether a stop or an affricate. This repair strategy is inapplicable to monomorphemic forms because gemination would incur a violation of the faithfulness constraint UNIFORMITY (McCarthy and Prince 1995). To clarify, this constraint blocks the merger of two root segments into a single segment. Hence, the formation of a consonant geminate, which does not underlyingly exist, leads not only to the violation of the constraint UNIFORMITY, but also to the violation of the MAX-V constraint. This violation is observed due to the vowel deletion to allow a geminate consonant to surface in monomorphemic form, as in /didʒa:dʒah/ 'chicken' → *[dʒ:a:dʒah]. The constraint UNIFORMITY is defined below in (4.27):

(4.27) UNIFORMITY

No element of the output has multiple correspondents in the input. (No coalescence)

The above constraint punishes any potential candidate forming an unfaithful mapping between the input and the output. The constraints UNIFORMITY and MAX-V should be low-ranked in order to enable geminate consonants with bimorphemic forms to surface in the language. To illustrate how the previous constraints interact in evaluating a potential geminate in monomorphemic form, consider the following tableau in (4.28):

(4.28) /diʤa:ʤah/ → [di.ʤa:.ʤah] 'chicken'

/diʤa:ʤah/	OCP-Cor [-son][-cont]	MAX-C	*i]σ	MAX-V	UNIFORMITY	*[σ CC
a. ☞ [di.ʤa:.ʤah]			*			
b. [dʤa:.ʤah]	*!			*		*
c. [d:a:.ʤah]		*!		*	*	
d. [ʤ:a:.ʤah]		*!		*	*	

As can be seen from the tableau above that candidate (a) is selected as the optimal because it respects the high-ranked constraints. Candidate (b) is eliminated due to serious violation of the constraints OCP-Cor[-son][-cont]. Candidates (c) and (d) are ruled out because they violate the faithfulness constraint MAX-C, which prohibits deletion.

It should be noted from tableau (4.28) that candidates (c) and (d) violate two low-ranked constraints, namely MAX-V and UNIFORMITY at the same time. I postulate a constraint that is eligible to penalise candidates that both have a deletion and a gemination for monomorphemic forms. To do so, I follow Alahmari (2018) in implementing 'Local Constraint Conjunction'. This is a mechanism in Optimality Theory to account for opacity in such a condition where a candidate violates two low-ranked constraints simultaneously in a particular domain (Smolensky 1995, 2005). Constraint conjunction allows violation of only one of the two constraints, whereas violation of the two conjoined constraints is not allowed (Moreton and Smolensky 2002). Accordingly, constraint conjunction confirms that candidates with an initial geminate are excluded through fusion of the two-ranked constraints MAX-V and UNIFORMITY into one conjunction constraint. Thus, integrating the two constraints into one constraint asserts that gemination in monomorphemic form is not allowed in the language. The conjoined constraint is defined below in (4.29):

(4.29) MAX-V& UNIFORMITY

Violations of MAX-V and UNIFORMITY cannot apply to the same word.

According to Kager (1999), the conjunctive constraint should be universally ranked above its component constraints, as in [C1 & C2] δ >> C1, C2. Therefore, the overall constraint ranking so far is outlined below in (4.30) to analyse prohibited monomorphemic initial consonant clusters.

(4.30) Constraint ranking for monomorphemic complex onset forms:

OCP-Cor[-son][-cont], MAX-V& UNIFORMITY >> *i]σ >> MAX-V >> UNIFORMITY, *[σ CC

Note that the constraint *i]σ is ranked between the conjunctive constraint and its component constraints in order to confirm that the high vowel /i/ does not surface elsewhere whenever complex onsets are formed. Now, let us attest the same input /diʤa:ʤah/ with the new proposed constraint ranking along with the conjunctive constraint and see how the optimal form is selected correctly in the following tableau (4.31). In this tableau, we adopt the ‘Local Constraint Conjunction’ account, which assists us in eliminating candidates (c) and (d) under the undominated constraint MAX-V& UNIFORMITY because these candidates incur two fatal violations at the same time. Candidate (b) fails to satisfy the high-ranked constraint and thus it is ruled out of the competition. Candidate (a) is the faithful form compared to other candidates and it is selected as the winner candidate because it obeys the high-ranked constraints.

(4.31) /diʤa:ʤah/ → [di.ʤa:.ʤah] ‘chicken’

/diʤa:ʤah/	OCP-Cor [-son] [-cont]	MAX-V& UNIFORMITY	MAX-C	*i]σ	MAX-V	UNIFORMITY	*[σ CC
a. ☞[di.ʤa:.ʤah]				*			
b. [dʤa:.ʤah]	*!				*		*
c. [d:a:.ʤah]		*!	*		*	*	
d. [ʤ:a:.ʤah]		*!	*		*	*	

After establishing the constraint ranking in (4.30), we should attest its validity with the permissible complex onsets in monomorphemic forms. To achieve this, consider the following tableau (4.32), which evaluates the allowed complex onset /ħsˤa:n/ ‘horse’ with the monomorphemic form to show how the previous constraint ranking can account for this type of complex onset in the dialect:

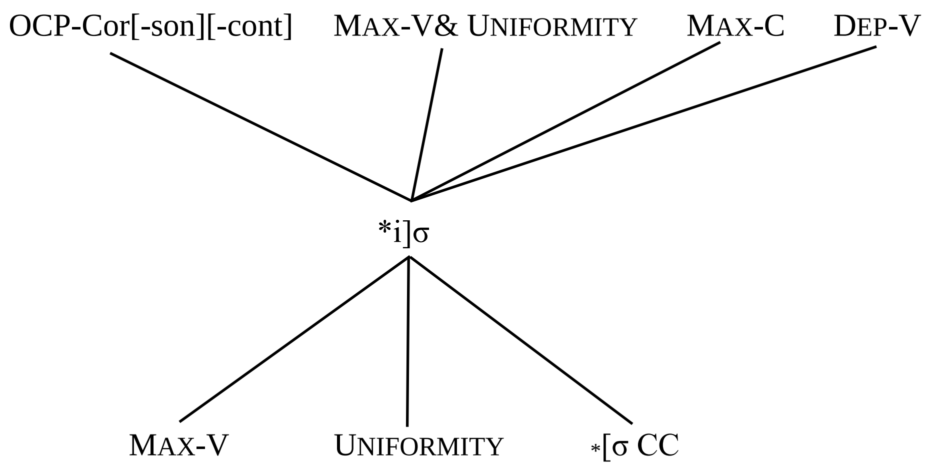
(4.32) /ħsˤa:n/ → [ħsˤa:n] ‘horse’

/ħsˤa:n/	OCP-Cor [-son] [-cont]	MAX-V& UNIFORMITY	MAX-C	*i]σ	MAX-V	UNIFORMITY	*[σ CC
a.☞ [ħsˤa:n]							*
b. [ħ:a:n]			*!			*	*
c. [sˤ:a:n]			*!			*	
d. [ħi.sˤa:n]				*!		*	

As seen in the above tableau, candidate (a) is selected as the winner form by virtue of satisfying all the undominated constraints and allowing only minimal violation under the low-ranked constraint *[σ CC. Candidates (b) and (c) are ruled out by the constraints MAX-C and UNIFORMITY in which /ħ/ and /sˤ/ are geminated in the output forms. Candidate (d) is ruled out because the high vowel /i/ insertion causes fatal violation of the constraint *i]σ, which in turn prevents the complex onset to surface. Note that the constraint OCP-Cor[-son][-cont] is obeyed because the onset cluster [ħsˤ] is composed of fricative followed by fricative. All in all, the constraint ranking in tableau (4.31) fits into the analysis of allowed and disallowed monomorphemic complex onset forms in the dialect.

A comparison between the two tableaux (4.31) and (4.32) posits an important difference in the operation of the conjunctive constraint MAX-V& UNIFORMITY and the constraint OCP-Cor[-son][-cont]. In terms of the conjunctive constraint MAX-V& UNIFORMITY, this constraint is active only with forms that contain an underlying vowel breaking up complex onsets, as shown in tableau (4.31). Thus, geminating the first or the second consonant results in violation of the conjunctive constraint MAX-V& UNIFORMITY simultaneously, such as in /diʤa:ʤah/ 'chicken' → [d:a:.ʤah] where the underlying high vowel /i/ is deleted and the first consonant is geminated. However, with forms that do not contain an underlying vowel and preserve complex onsets in underlying representations, the conjunctive constraint MAX-V& UNIFORMITY is inactive because geminating the first or the second consonant will not lead to violation of the constraint MAX-V; it only leads to violation of the low-ranked constraint UNIFORMITY due to the ban on the consonant coalescence. This is observed by the fact that complex onsets are realised both in the underlying and surface forms, such as in /ħsˤa:n/ 'horse' → [ħ:a:n]. Taking the constraint OCP-Cor[-son][-cont] into consideration, we find that this constraint is violated only when an onset cluster contains a stop followed by an affricate in tautosyllabic contexts, as shown in tableau (4.32). Thus, the onset cluster [ħsˤ] satisfies the high-ranked constraint OCP-Cor[-son][-cont] since both segments are fricatives. The overall constraint ranking proposed so far of monomorphemic onset clusters is sketched in diagram (4.33) below:

(4.33) The combined constraint ranking of forbidden monomorphemic complex onsets



Summing up so far, we discussed the forbidden monomorphemic complex onsets in NNA. We observed that the underlying high vowel /i/ preservation is the only way to prevent a potential monomorphemic complex onset from surfacing due to the constraint OCP-Cor[-son][-cont] effect. Vowel epenthesis, as a repair strategy, is typically inapplicable with such monomorphemic forms because it violates faithfulness constraints, such as DEP-V. In addition, the high vowel /i/ is already existed underlyingly, and it should be preserved in the surface form to satisfy the undominated constraint OCP-Cor[-son][-cont]. Thus, we do not need to insert a vowel to break up such forbidden monomorphemic complex onsets. The other repair strategy is gemination (assimilation), which is limited to bimorphemic complex onsets but not observed with forbidden monomorphemic complex onsets due to violation of the undominated conjunctive constraint MAX-V& UNIFORMITY.

In the next subsection, I will address two phonological processes; namely, vowel epenthesis and gemination (assimilation) that motivate the prohibition of potential bimorphemic onset clusters by the constraint OCP-Cor[-son][-cont].

2. Forbidden Bimorphemic Complex Onsets

This subsection addresses the issue of forbidden complex onsets with bimorphemic forms in NNA. These onset clusters can result from morpheme concatenation where a prefix links to a stem-initial consonant. All the attested impermissible onset clusters are avoided through either gemination or vowel epenthesis in bimorphemic forms due to the Obligatory Contour Principle

(OCP). As previously discussed in (4.8), there are two types of prohibited onset clusters in bimorphemic forms that are avoided via gemination as a result of two OCP constraints. Two OCP constraints are created based on the cluster pattern type. The first constraint OCP-Cor[-son][-cont] is relevant when any coronal obstruent onset cluster contains a stop followed by a stop or a stop followed by an affricate and shares the manner specification [-cont]. The second constraint OCP-Cor [-son][-strid] is relevant when any coronal obstruent onset cluster contains a stop followed by a fricative and shares the manner specification [-strid]. The OCP constraints will be discussed in (a) and (b) below:

a. OCP-Cor[-son][-cont] Blocked by Gemination (Assimilation)

In light of the OCP constraint, coronal obstruent onset clusters that share a similar manner feature [-cont] are not tolerated in the dialect. Therefore, the repair for this is to geminate the stem-initial consonant. For example, the underlying representation /t-dar:is/ ‘you (fem.) teach’ is realised as [d:ar.ris], where the prefix [t-] ‘you’ and the stem-initial consonant are coronal obstruents and share the same manner feature [-cont]. To avoid the onset cluster [td], the prefix [t-] and the stem-initial consonant [d] are merged into a single segment forming an initial geminate [d:]. Consequently, the fusion of two segments into one segment results in coalescence, which in turn incurs a violation of the faithfulness constraint UNIFORMITY (McCarthy and Prince 1995) that militates against coalescence. However, the high-ranked constraint OCP-Cor[-son][-cont] is satisfied, allowing the optimal form to surface in the language. This interpretation clearly shows that these constraints are in conflict, interacting with each other to generate an initial geminate for bimorphemic forms. To show this interaction, the following tableau (4.34) illustrates the evaluation of the input /t-tˤa:mir/ ‘you (mas.) are jumping’:

(4.34) /t-tˤa:mir/ → [tˤ:a:.mir] ‘you (fem.) are jumping’

/t_1-$tˤ_2$a:mir/	OCP-Cor [-son][-cont]	UNIFORMITY
a.☞[$tˤ:_{1,2}$a:.mir]		*
b. [$t_1tˤ_2$a:.mir]	*!	

Tableau (4.34) shows that candidate (a) is selected as the winner form over candidate (b) by virtue of respecting the constraint OCP-Cor[-son][-cont] and forming an initial geminate consonant to avoid forbidden onset clusters in the language. Candidate (b) fails to surface as an optimal form, although it is the faithful candidate due to a fatal violation by the high-ranked constraint OCP, generating an impermissible initial complex onset. In spite of that, this tableau remains somewhat unclear about the realisation of the prefixal morpheme [t_1] in the output after coalescence. Unlike the coalescence process, geminating the prefix to a stem-initial consonant preserves partial or full identity of the prefixal morpheme. In order to maintain the prefixal morpheme, we will invoke the faithfulness constraint MAX-C that militates against consonants including prefix deletion.

The prefixal morpheme [t-] 'you' is overtly realised when an initial cluster is geminated in bimorphemic forms after coalescence. That is, the constraint OCP is respected since the impermissible onset cluster is prevented from surfacing. However, the same form would violate the constraint UNIFORMITY due to the coalescence process. The faithfulness constraint MAX-C should be ranked above the constraint UNIFORMITY in order to eliminate any potential candidate missing the prefixal morpheme in the surface forms. To illustrate how the constraints MAX-C and UNIFORMITY interact with each other for the sake of generating the correct output form, consider the following tableau (4.35):

(4.35) /t-tˤa:mir/ → [tˤ:a:.mir] 'you (fem.) are jumping'

/t_1-$tˤ_2$a:mir/	OCP-Cor [-son][-cont]	MAX-C	UNIFORMITY	*[σ CC
a. ☞ [$tˤ:_{1,2}$a:.mir]			*	*
b. [$t_1tˤ_2$a:mir]	*!			*
c. [$tˤ_2$a:.mir]		*!		

Candidate (a) is the optimal form since it obeys the two undominated constraints. Candidate (b) is ruled out by the OCP constraint because it allows the forbidden complex onset to surface. Candidate (c) does not realise the prefixed morpheme [t-] 'you', thus it is eliminated by the high-ranked constraint MAX-C.

As stated earlier, the forbidden complex onsets in bimorphemic forms are formed from what is called ‘regressive assimilation’. The direction of assimilation shows that the prefix [t-] ‘you’ assimilates to the stem-initial consonant like [tˤ]. This denotes that there is a priority to retain the features of root segments over a priority to retain affix morphemes in the dialect, as presented earlier in (4.9/2) and (4.14/2). This behaviour is translated into the faithfulness constraint IDENT-ROOT-FEATURE, which is adopted from (McCarthy and Prince 1995) and modified to fit into the current analysis, as shown in (4.36):

(4.36) IDENT-ROOT-FEATURE (McCarthy and Prince 1995)

Every feature of a root’s input has a correspondent in the output.

This constraint is violable and eligible to rule out any candidate losing the features of root segments, which are impacted by morphological or phonological generalisations. To achieve this, the following tableau (4.37) exhibits the interaction between the markedness constraint OCP-Cor[-son][-cont] and the faithfulness constraint IDENT-ROOT-FEATURE to obtain the correct surface representation from the input /t-tˤa:mir/ ‘you (fem.) are jumping’.

(4.37) /t-tˤa:mir/ → [tˤ:a:.mir] ‘you (fem.) are jumping’

/t_1-$tˤ_2$a:mir/	OCP-Cor [-son][-cont]	IDENT-ROOT-FEATURE	MAX-C	DEP-V	UNIFORMITY	*[σ CC
a. ☞ [tˤ:$_{1,2}$a:.mir]					*	*
b. [$t_1$$tˤ_2$a:mir]	*!					*
c. [t:$_{1,2}$a:.mir]		*!			*	*
d. [t_1a:.mir]			*!			
e. [$tˤ_2$a:.mir]			*!			
f. [t_1a.$tˤ_2$a:.mir]				*!		

Tableau (4.37) shows that candidate (a) is selected as the winner form by virtue of satisfying the undominated constraints at the expense of incurring minimal violations of the constraints UNIFORMITY and *[σ CC. Candidate (b) is quickly ruled out by the high-ranked constraint OCP-Cor[-son][-cont]. Candidate (c) is eliminated for incurring a fatal violation of the high-ranked constraint IDENT-ROOT-FEATURE because the emphatic stop /tˤ/ is not realised in the surface forms. In this situation, the constraint IDENT-ROOT-FEATURE checks that the distinctive specification [+voice] of the stem-initial consonant /tˤ/ is realised in the output. Candidates (d) and (e) are ruled out because they fail to satisfy the constraint MAX-C. Finally, candidate (f) is eliminated due to violation of the faithfulness constraint DEP-V whereby vowel epenthesis is not utilised as a repair strategy with such forms, as opposed to some modern Arabic dialects.

b. OCP-Cor [-son][-strid] Blocked by Gemination

This subsection discusses forbidden coronal complex onsets in bimorphemic forms that share the same specification [-strid], i.e., non-sibilant coronal obstruents. These onset clusters are composed of a combination of a stop followed by a root-initial fricative. In order to avoid the co-occurrence of such clusters, gemination takes place as a repair strategy, such as /t-ðˤaħ:i/ 'you (fem.) sacrifice', which surfaces as [**ðˤ:**aħ.ħi], where the prefix stop [t-] assimilates to the fricative /ðˤ/ forming the geminate /ðˤ:/. The former constraint OCP-Cor[-son][-cont] in (4.27) is then not applicable here since it is not violated. Thus, we should advocate for a constraint that resists any complex onset that contains a combination of a stop and a fricative. This constraint replaces the previous one and acquires the same ranking as defined in (4.38) below:

(4.38) OCP-Cor[-son][-strid]

Assign one violation for any two consonants with the features [+Cor, -Strid] which are adjacent in the output of the onset.

The following tableau (4.39) demonstrates how the optimal candidate is selected, depending on the interaction holds between the constraint OCP-Cor[-son][-strid] and the former constraints for the input /t-ðˤaħ:i/ 'you (fem.) sacrifice':

(4.39) /t-ða:kir/ → [ð:a:.kir] 'you (fem.) study'

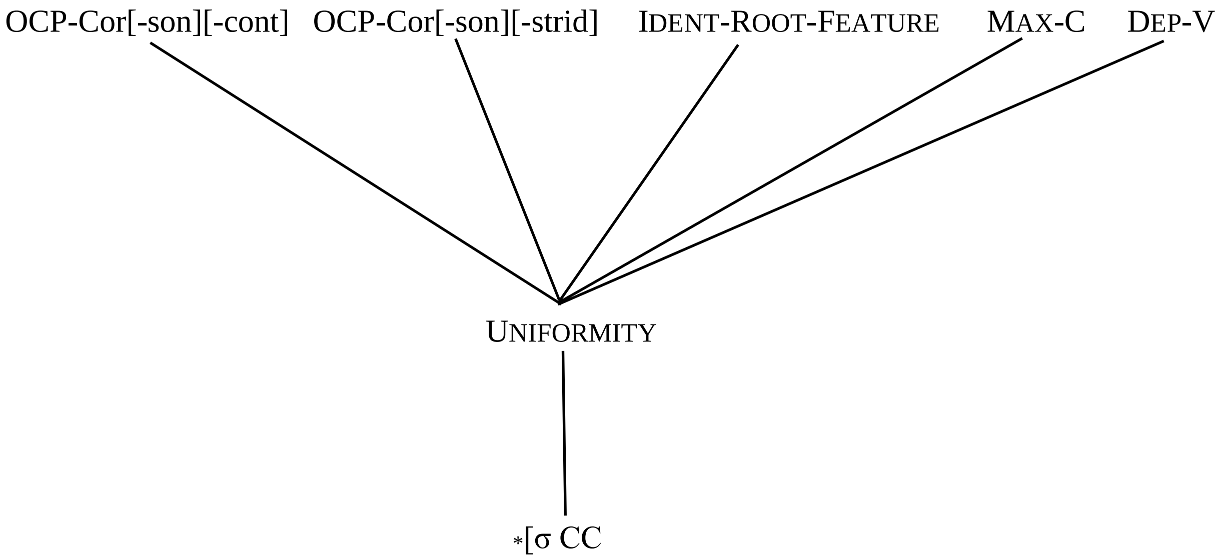
/t_1-$ð_2$a:kir/	OCP-Cor [-son][-strid]	IDENT-ROOT-FEATURE	MAX-C	DEP-V	UNIFORMITY	*[σ CC
a. ☞ [ð:$_{1,2}$a:.kir]					*	*
b. [$t_1$$ð^ʕ_2$ a:.kir]	*!					*
c. [t:$_{1,2}$a:.kir]		*!			*	*
d. [t_1a:.kir]			*!			
e. [$ð_2$a:.kir]			*!			
f. [t_1i.$ð_2$a:.kir]				*!		

This tableau shows that candidate (a) is selected as the winner output because it satisfies the high-ranked constraints, especially OCP-Cor[-son][-strid], and allows only a minimal violation under the low-ranked constraints UNIFORMITY and *[σ CC. Candidate (b) is immediately ruled out because the formation of an onset cluster containing a stop plus a fricative leads to violation of the top high-ranked constraint OCP. In candidate (c), the root-initial consonant /ð/ is not realised in the output and thus it is eliminated from the competition. Candidates (d) and (e) are eliminated by the constraint MAX-C, which bans segment deletion in the output. Finally, in NNA, vowel epenthesis is not utilised as a repair strategy with this type of onset cluster, thus candidate (f) fails to satisfy the constraint DEP-V, which bans vowel epenthesis.

To conclude the previous observations in (a) and (b), the co-occurrence of certain complex onsets with bimorphemic forms are prohibited to surface in the language due to the OCP effect. Thus, these forms are avoided by utilising one repair strategy, namely, gemination. Two OCP constraints are formed based on the cluster pattern type. The first constraint, OCP-Cor[-son][-cont], is active only when any coronal obstruent onset cluster contains a stop followed by a stop or a stop followed by an affricate and shares the manner specification [-cont]. The second constraint, OCP-Cor [-son][-strid], is active only when any coronal obstruent onset cluster contains a stop followed by a fricative and shares the specification [-strid]. These constraints are highly ranked in order to eliminate the co-occurrence of two obstruent segments that share the same place feature, whether [-cont] or [-strid]. In contrast, the constraint UNIFORMITY should be ranked lower in order to maintain the optimal form that merges the two segments into a single segment (coalescence).

We have two types of forbidden onset clusters of bimorphemic forms in the language. The general constraint ranking for forbidden onset clusters of bimorphemic forms are introduced in the following diagram, as shown in (4.40):

(4.40) Summary of constraint ranking for forbidden bimorphemic complex onsets



4.10.3 Final Consonant Clusters and Sonority

In NNA, complex codas are tolerated when they appear at the right edge of a word and word-internally after suffixation. These clusters can be seen monomorphemically and bimorphemically. Unlike complex onsets, the formation of complex codas is often imposed by the Sonority Sequencing Principles (Clements 1990). To clarify, coda clusters with falling sonority are permitted due to adherence to the SSP, such as /ʃams/ 'sun'→ [ʃa**ms**], whilst coda clusters with rising sonority are illicit, such as /ħizn/ 'sadness' → [ħi.z**i**n]. It is notable that the coda cluster with falling sonority is left intact, whereas the one with rising sonority is split by a vowel epenthesis to avoid such clusters from surfacing. On the other hand, coda clusters with plateau sonority pose a problem in which obstruent coda cluster patterns violate the SSP, such as /nafs/ 'soul' → [nafs], but nasal coda cluster patterns are repaired by an epenthetic vowel, such as /ʔamn/ 'safety' → [ʔa.min]. A question that naturally arises and needs consideration is why we break up the coda cluster of nasals by an epenthetic vowel but not with obstruent coda clusters, even though they are both classified under plateau sonority. The answer is that the sonorant coda clusters, and particularly nasal ones require a vowel to their left. As a result, vowel epenthesis is implemented to avoid nasal coda clusters (see section 4.5 for more detail).

We now turn to the tolerated monomorphemic coda clusters with falling and plateau (obstruents) sonority profiles. In OT, since coda clusters are allowed in the dialect, a constraint that militates against coda clusters should be adopted and ranked lower to preserve the coda cluster in the output. This constraint is repeated in (4.41) below:

(4.41) *COMPLEX^{COD} *CC] σ (Kager 1999)

Codas are simple.

The constraint in (4.41) penalises any biconsonantal coda clusters. Also, the faithfulness constraint DEP-V outranks the constraint *CC] σ in order to rule out any candidate that allows vowel insertion to break up a well-formed coda cluster. The following tableaux (4.44) and (4.42) exhibit the OT analysis for permitted coda clusters with falling and plateau sonority patterns:

(4.42) /bint/ → [bint] 'girl'

/bint/	DEP-V	*CC] σ
a.☞[bint]		*
b. [bi.nit]	*!	

(4.43) /fisg/ → [fisg] 'depravity'

/fisg/	DEP-V	*CC] σ
a.☞[fisg]		*
b. [fi.sig]	*!	

Tableau (4.42) shows that the coda cluster [nt] with falling sonority is permitted and selects the faithful candidate (a) as the winner form because it satisfies the undominated constraint DEP-V. In tableau (4.43), the coda cluster [sg] with equal sonority is permitted and selects the faithful form (a) as the optimal output because it only allows for minimal violation of the constraint *CC] σ, which bans complex codas. In short, no repair strategy is utilised to avoid coda clusters with falling and equal (obstruents) sonority.

In the next subsection, I will account for prohibited peripheral complex codas with monomorphemic and bimorphemic forms, respectively.

4.10.4 Forbidden Final Consonant Clusters

We have two types of prohibited complex codas in the dialect. The first type involves monomorphemic nasal coda clusters with plateau sonority and those with rising sonority. The second type involves bimorphemic coda clusters, which result from morpheme concatenation. Starting with forbidden monomorphemic coda clusters with rising sonority, this study has found that such clusters occur when the segment in the right edge has greater sonority than the consonant closer to the nucleus. Therefore, this type of coda clusters cannot abide to the SSP. In OT terminology, to account for the forbidden coda clusters with rising sonority, we should adopt a constraint that bans a rising sonority in a coda biconsonantal cluster. This constraint is presented in (4.44) below:

(4.44) CODA SONORITY SEQUENCE (CODASONSEQ) (Clements 1990)

Coda clusters with rising sonority are not allowed.

The constraint above rules out any coda cluster where the second member is greater than the first member of a coda cluster in terms of sonority. Thus, the markedness constraint should CODASONSEQ outrank both constraints DEP-V and *CC] σ in order to eliminate a coda cluster with rising sonority and to yield the correct surface form with an epenthetic vowel in the dialect. To achieve this, the following tableau in (4.45) evaluates the input /ħizn/ ‘sadness’:

(4.45) /ħizn/ → [ħi.zin] ‘sadness’

/ħizn/	CODASONSEQ	DEP-V	*CC] σ
a. [ħizn]	*!		*
b. ☞[ħi.zin]		*	

Tableau (4.45) illustrates that candidate (a) surfaces as the most faithful output, but it is ruled out due to fatal violation of the top high-ranked constraint CODASONSEQ. Candidate (b) occurs with an epenthetic vowel, which is considered a well-formed output due to adherence to general concept of the SSP. Hence, this candidate emerges as the optimal output by virtue of satisfying the high-ranked constraint CODASONSEQ.

Moving on to the monomorphemic coda clusters with plateau sonority, we have seen that obstruent coda clusters with plateau sonority are allowed in the language. However, a combination of nasal plus nasal of coda clusters are avoided by an epenthetic vowel. This avoidance is due to the requirement of an epenthetic vowel to the left of coda sonorants (i.e., nasals). In an OT perspective, to prevent the occurrence of final nasal clusters, we adopt the constraint *PLATEAU-N]σ in order to eliminate any output containing a coda cluster of nasals with qual sonority. This constraint is modified and expressed in (4.46) below:

(4.46) *PLATEAU-N]σ (AlMotairi 2015: 73-74).

No final (Nasal + Nasal) sequences with plateau sonority.

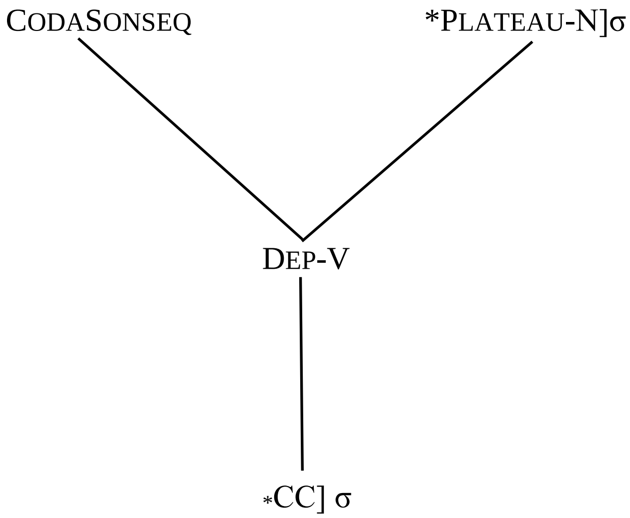
This markedness constraint should be ranked higher to rule out any candidate involving two final nasal clusters in the coda position. A coda cluster of nasals is repaired by an epenthetic vowel to avoid violating the former markedness constraint and disallowing final nasal sequences to surface in the language. To illustrate how the constraint in (4.46) interacts with the constraints DEP-V and *CC, consider the following tableau (4.47), which evaluates the input /samn/ 'ghee':

(4.47) /samn/ → [sa.min] 'ghee'

/samn/	*PLATEAU-N]σ	DEP-V	*CC] σ
a.☞[sa.min]		*	
b. [samn]	*!		*

The tableau shows that candidate (a) is selected as the winner because it satisfies the high-ranked constraint *PLATEAU-N]σ and allows for minimal violation of the constraint DEP-V. Candidate (b) is immediately eliminated due to fatal violation of the undominated constraint because it allows final nasal sequences to surface. The overall constraint ranking of forbidden monomorphemic complex codas is presented in the following diagram (4.48):

(4.48) Summary of constraint ranking for prohibited monomorphemic complex codas



After establishing the OT analysis for forbidden monomorphemic coda clusters, we will now account for forbidden bimorphemic coda clusters in NNA. This is the second type of forbidden bimorphemic coda clusters, which results from morpheme concatenation. These coda clusters are banned from surfacing in the language due to the effect of the OCP. The process of gemination, as a repair strategy, is implemented in order to avoid such clusters, as has been seen in the formation of initial biconsonantal clusters. We have already presented two OCP constraints that prevent the co-occurrence of [-cont] coronal obstruents and those of [-strid] coronal obstruents. The assimilation process in forbidden complex codas is called progressive assimilation in which the suffix [t-] assimilates to a stem-final consonant, as opposed to the assimilation process found in forbidden bimorphemic complex onsets. The directionality of assimilation shows that the constraint IDENT-ROOT-FEATURE is robustly respected in both bimorphemic complex onsets and codas in the language. Overall, the suffix [t-] is subject to progressive assimilation to a stem-final consonant when the OCP constraint is violated. Therefore, the same constraints will be adopted as presented in tableau (4.25) to account for forbidden bimorphemic coda clusters of coronal obstruents sharing a similar manner feature [-cont], except for the constraint [σ CC, which should be replaced by its counterpart constraint *CC] σ. Now, we will see how the constraint ranking was proposed in earlier works for the forbidden coda clusters of coronal obstruents. The following tableau (4.49) evaluates the input /sˤaʕad-t/ ‘I escalated’:

(4.49) /sˤaʕad-t/ → [sˤaʕad:] 'I escalated'

/sˤaʕad$_1$-t$_2$/	OCP-Cor [-son][-cont]	IDENT-ROOT-FEATURE	MAX-C	DEP-V	UNIFORMITY	*CC] σ
a. ☞ [sˤaʕad:$_{1,2}$]					*	*
b. [sˤa.ʕad$_1$t$_2$]	*!					*
c. [sˤa.ʕat:$_{1,2}$]		*!			*	*
d. [sˤa.ʕat$_2$]			*!			
e. [sˤa.ʕad$_1$]			*!			
f. [sˤa.ʕa.d$_1$it$_2$]				*!		

It should be noted here that the constraint ranking established earlier to account for forbidden bimorphemic complex onsets fits ideally to account for forbidden bimorphemic complex codas. Candidate (a) is the optimal output because it avoids violation of the undominated constraints. Candidate (b) allows for two identical adjacent stop segments to occur, which leads to fatal violation of the high-ranked OCP constraint. Candidate (c) does not satisfy the undominated constraint IDENT-ROOT-FEATURE because the root segment feature [d] is skipped in the outputs. Candidates (d) and (e) are ruled out due to violation of the constraint MAX-C. Finally, candidate (f) fails to satisfy the faithfulness constraint DEP-V, which bans vowel epenthesis.

As mentioned previously, the former OCP constraint is designed to account for forbidden bimorphemic onset and coda clusters that contain a combination of a stop plus a stop or a stop plus an affricate. However, to account for forbidden bimorphemic coda clusters that contain a combination of a stop plus a fricative, we should adopt the same OCP constraint that was utilised with forbidden bimorphemic complex onsets. Thus, the previous OCP constraint should be replaced with the one that fits into the coda cluster of a stop plus a fricative that shares the same manner feature [-strid], such as *[ðˤt] and *[θt]. These types of coda clusters are avoided through gemination as found in bimorphemic onset clusters. Therefore, the same constraint ranking in (4.49) will be utilised, except for the OCP constraint, to account for the coda cluster of a stop plus a fricative, as shown in tableau (4.50) below:

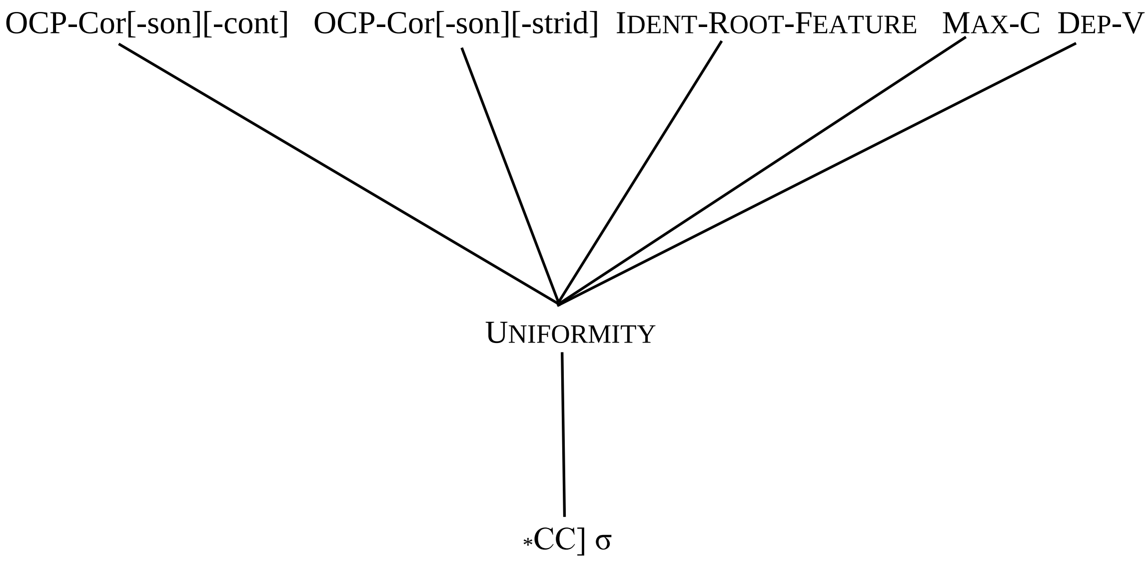
(4.50) /faraðˤ-t/ → [faraðˤ:] ‘I imposed’

/faraðˤ$_1$-t$_2$/	OCP-Cor [-son][-strid]	IDENT-ROOT-FEATURE	MAX-C	DEP-V	UNIFORMITY	*CC] σ
a. ☞ [fa.raðˤ:$_{1,2}$]					*	*
b. [fa.raðˤ$_1$t$_2$]	*!					*
c. [fa.rat:$_{1,2}$]		*!			*	*
d. [fa.rat$_2$]			*!			
e. [fa.raðˤ$_1$]			*!			
f. [fa.ra.ðˤ$_1$it$_2$]				*!		

It can be observed that candidate (a) is selected as the optimal form since the prohibited coda cluster [ðˤt] is repaired by gemination to avoid violating the undominated constraints, especially the top high-ranked constraint OCP. In contrast, candidate (b) is immediately ruled out by the undominated OCP constraint. Candidate (c) is eliminated due to serious violation of the constraint IDENT-ROOT-FEATURE. Candidates (d), (e), and (f) are ruled out from the competition because they violate different constraints, such as those in tableau (4.49).

To recap, we have covered the OT analysis of forbidden final complex word edges in NNA. Some coda cluster patterns are prohibited from surfacing due to the OCP restrictions. In NNA, these coda cluster patterns are prone to gemination, as a result of progressive assimilation, to obstruct such clusters from surfacing. More to the point, the two proposed OCP constraints for prohibited coronal obstruent onset clusters are adopted again to analyse the prohibited coronal obstruent coda clusters. The first OCP constraint is OCP-Cor[-son][-cont], which applies to a sequence of a stop plus a stop or a stop plus an affricate. The second OCP constraint is OCP-Cor[-son][-strid], which applies to a sequence of a stop plus a fricative. In OT, these high-ranked constraints are able to rule out any candidate that appears with such coda clusters. The UNIFORMITY constraint should be ranked below to enable the optimal form with a geminate to surface in the dialect. All in all, in a language with a harmonic grammar, limitations that apply to the left edge of the phonological word are naturally anticipated to apply to the right edge. Strikingly, except for the SSP constraint, which applies only to complex codas to a large extent, the OCP restrictions are completely applicable in the formation of the presented complex onset and coda clusters. The overall constraint ranking for forbidden coda clusters in bimorphemic forms are introduced in the following diagram, as shown in (4.51):

(4.51) Summary of constraint ranking for forbidden bimorphemic complex codas



The remainder of this section will address the OT analysis of the ban on the heterosyllabic consonant clusters in NNA, namely, internal triconsonantal clusters.

4.10.5 Internal Triconsonantal Clusters

NNA disallows medial -CCC- sequences after affixation. The avoidance of internal triconsonantal clusters results from the vowel epenthesis process, such as /sˤiħ-l-hin/ ‘call them (fem.)!’ which renders as [sˤiħ.li.hin] (recall the internal -CCC- sequence discussion in 4.2 and 4.9.2 for details). In OT terms, we should adopt a constraint that militates against internal triconsonantal clusters in the current analysis. This constraint was introduced earlier in Chapter Three and repeated below in (4.52) for convenience:

(4.52) *-CCC- (McCarthy and Prince 1995)

A sequence of internal three consonants is not allowed in the output.

This constraint is in interaction with the faithfulness constraint DEP-V which breaks up internal triconsonantal clusters in the surface from. Thus, the constraint *-CCC- outranks the faithfulness DEP-V in order to prevent the occurrence of internal -CCC sequences. To demonstrate how the markedness constraint *-CCC- interacts with the faithfulness constraint

DEP-V to enhance the ban on internal triconsonantal cluster in the dialect, consider the following tableau (4.53):

(4.53) /ja-ktb-u:n/ → [jak.ta.bu:n] ‘they (mas.) are writing’

/ja-ktb-u:n	*-CCC-	DEP-V
a. ☞ [jak.ta.bu:n]		*
b. [jak.tbu:n]	*!	

As can be observed from tableau (4.53), candidate (a) emerges as the optimal output because it satisfies the undominated constraint *-CCC- which disallows the internal triconsonantal cluster. This leads to minimal violation of the low-ranked constraint DEP-V. However, candidate (b) loses the competition because it allows the internal -CCC- sequence to surface. The general constraint ranking for the ban on internal triconsonantal clusters in NNA is listed under the diagrams in (4.54):

(4.54) Summary of constraint ranking for the ban on internal -CCC- clusters

*-CCC-

|

DEP-V

In closing, this section has provided an OT analysis for heterosyllabic triconsonantal clusters in NNA. We found that this type of cluster does not surface in the language by virtue of vowel epenthesis which splits such clusters. In OT terms, if the constraint DEP-V is dissatisfied, then a -CCC- sequence does not surface in the dialect because an epenthetic vowel breaks up such clusters. On the other hand, if the constraint DEP-V is satisfied, a -CCC- sequence is realised in the surface form. Overall, the constraint *-CCC- is preferred over the constraint DEP-V in the dialect.

4.11 Summary

This chapter highlighted the phonotactic restrictions on the formation of consonant clusters in NNA under the tenets of Optimality Theory (OT). In particular, we discussed the formation of tautosyllabic and heterosyllabic consonant clusters. Tautosyllabic consonant clusters involve complex onsets and codas, and heterosyllabic consonant clusters involve coda-onset clusters and internal -CCC- sequences. Cross-linguistically, the formation of all consonant cluster types may be governed by different phonological approaches, such as the Sonority Sequencing Principle (SSP), Syllable Contact Law (SCL), and Obligatory Contour Principle (OCP).

By examining the SSP with the formation of complex onsets, it was demonstrated that the SSP is not entirely obeyed when forming complex onsets with the three sonority types in NNA. In flat and rising sonority profiles, no repair strategy is utilised in order to split such violated onset clusters. On the other hand, it should be noted that NNA speakers adhere to the SSP when forming complex codas with all sonority types, except for the obstruent coda clusters in an equal sonority profile. More to the point, in plateau sonority, NNA speakers tolerate complex coda of obstruents but not with sonorants (nasals) coda clusters. Therefore, NNA speakers only split sonorant clusters in coda position by an epenthetic vowel because sonorants require a vowel to their left in coda position, such as the word /samn/ ‘ghee’ yielding [sa.m**i**n].

Nevertheless, this is not the entire story, since not all word edge clusters are tolerated in the language. NNA forbids some monomorphemic and bimorphemic complex onsets and codas due to the effect of the OCP. In this study, the main focus of forbidden onset and coda cluster patterns is on the obstruent coronal consonant clusters only, which involve stops, fricatives, and affricates. Regarding forbidden complex onsets, the presented data show that we have monomorphemic and bimorphemic forbidden complex onsets. In monomorphemic forms, they are avoided through what I term ‘the preservation of the underlying high vowel /i/’ for the sake of preventing initial onset clusters to emerge, such as the combination of a stop plus an affricate *[tʤ]. This proposal has caused an issue when it comes to the proposed rule OCP-Cor[-son][-cont], which treats stops and affricates for the manner feature as [-cont], whilst fricatives as [+cont]. Thus, we should treat an affricate /ʤ/ as two separate segments in which the left edge of the affricate is treated as a stop, whilst the right edge like a fricative. Therefore, I assumed that affricates are analysed under two different manner features, where a stop as [-cont] and a fricative as [+cont] to justify why a cluster like [ʤd] is allowed but its mirror image *[dʤ] is not allowed to surface in the language. In bimorphemic forms, some forbidden coronal obstruent onset clusters NNA are prone to gemination to ban some onset clusters such as *[tt], *[td], *[ttˤ], *[tʤ], *[tðˤ], and *[tð], which in turn surface as geminates /tː/, /dː/, /tˤː/, /ʤː/, /ðˤː/, and /ðː/, respectively. A new OCP constraint has been proposed in order to analyse forbidden onset clusters containing a combination of a stop plus a fricative that shares the same manner specification [-strident]. Hence, OCP-Cor[-son][-strid] was able to represent prohibited coronal obstruent clusters.

In complex codas, it has been observed earlier that complex codas in NNA are mostly imposed by the SSP restrictions. Nevertheless, it seems that we have some exceptions in that the obstruent coda clusters in an equal sonority profile are maintained. However, nasal coda clusters with monomorphemic forms are resolved by the implantation of vowel epenthesis as a repair strategy to break up the cluster. Vowel epenthesis is utilised because sonorants (nasals) require a vowel to their left in coda position. In bimorphemic forms, gemination is provoked in order to prevent the co-occurrence of a stop plus a stop or a stop plus a fricative in the language. The same OCP constraints presented with the prohibited complex onsets were implemented to the forbidden complex codas.

Chapter 5. Stress Assignment and Foot Construction

5.1 Introduction

Cross-linguistically, predictable stress systems are governed by two essential factors: syllable weight, and the position of the potential stressed syllable with respect to a word edge, i.e., the left or right edge of the prosodic word (Hyman 1985, Prince and Smolensky 1993). A large number of studies have investigated stress assignment and foot construction in a wide range of languages, including Arabic dialects. These studies have implemented different theoretical approaches in order to account for stress systems. Historically, the description of stress assignment has been developed beyond the generative analysis at segmental level, as shown in (Chomsky and Halle 1968, Broselow 1976, Johnson 1979), where a vowel assigns the feature [+stress] in the word. With the advent of the metrical approach to phonology, a plausible advance analysis has been noticed to account for stress assignment based on stress syllable weight rather than segment-based, as in the studies of McCarthy (1980) and Hayes (1981, 1989, 1995).

In Arabic and its contemporary dialects, stress assignment and foot construction have been a topic of considerable interest in the phonological literature (McCarthy 1979b, Kenstowicz, 1980, 1994, Abu-Salim 1982, Irshid 1984, Al-Mozainy *et al.* 1985, Almohanna 1998, Adra 1999, Watson 2002, Kabrah 2004, Bamakhramah 2009, Kager 2009, Alahmari 2018, Alhuwaykim 2018). It has been reported that stress in Arabic is always sensitive to syllable weight and position, where bimoraic syllables usually attract stress in the word. However, a key difference across Arabic varieties centres around the following questions: (a) what the distance of the stress window from the right or left edge of the word is (i.e., up to antepenultimate vs. pre-antepenultimate) and what is the direction of footing (i.e., left-to-right vs. right-to-left) is, (b) in the presence of more than one heavy syllable within the same word, which syllable attracts stress. (c) how to construct feet with various syllable structures, (d) how to treat a heavy syllable versus a superheavy syllable regarding stress assignment in different word positions (finally and non-finally), and finally (e) to what extent degenerate feet are tolerated. Although several studies have investigated stress assignment and foot construction in a wide range of modern Arabic dialects, no attempt has been made to account for stress system and foot construction in Northern Najdi Arabic (NNA). The current study is an effort to explore and analyse the general stress patterns and foot construction in NNA. Throughout the analysis, I will adopt three theoretical models, namely, Moraic Theory, Metrical Stress Theory, and Optimality Theory.

This chapter is laid out as follows. Section 5.2 introduces a typological overview of word stress along with stress patterns found in Classical Arabic (CA). Section 5.3 offers a detailed description of stress assignment, including how stress shift takes place under the effect of derived environments and some phonological processes in NNA. Section 5.4 provides a discussion of foot construction, which is based on the stress patterns found in the dialect. Section 5.5 presents an analysis couched in the framework of Optimality Theory (OT) to account for general stress patterns and foot construction in NNA. Finally, section 5.6 summarises the whole chapter.

5.2 An Overview of Word Stress

Cross-linguistically, stress is culminative in that every content word must contain at least one and only one stressed syllable, thus one foot (Kager 1995: 371). In a multisyllabic word, for instance, one syllable is more prominent than others. This syllable tends to be produced with higher intensity, greater loudness, and longer duration in relation to other neighbouring syllables (Gordon and Roettger 2017). That is, these features are correlated with stressed syllables because they are phonetically prominent. In English, for instance, stress falls on the antepenultimate when the ultimate is a light syllable in words containing at least three syllables, such as [ˈredʒɪmənt] where the initial syllable is considered to be more prominent than the others (Hayes 2009: 285). Generally, stress can be free (phonemic) or fixed (non-phonemic). The distribution of free stress is said to be unpredictable and may have different meanings, as in English, Spanish, and Russian. For example, in Spanish, two words with similar segmental content can have distinct stress patterns and meanings, such as [ˈsa.ßa.na] ‘sheet’ vs. [sa.ˈßa.na] ‘savannah’ (Fuchs 2018: 1). Similarly, in English, the word ‘subject’ can have different meanings and lexical categories, depending on the position of the stressed syllable. That is, when stress falls on the penultimate syllable, the word [ˈsʌb.ʤɪkt] is classified as a noun, meaning a topic of discussion or a course studied. Otherwise, if stress falls on the ultimate syllable, the word [səb.ˈʤɛkt] becomes a verb, meaning to cause something or someone to subdue. On the other hand, the distribution of fixed stress is said to be phonologically predictable, and it does not change the lexical category and the meaning, as in Polish, Finnish, and French. For example, in Polish, the penultimate syllable is always stressed when we have words with two or more syllables, such as [te.le.ˈvi.zor] ‘TV’ and [te.le.vi.ˈzor.ek] ‘little TV’ (Hayes 2009: 273-274).

In Classical Arabic (CA), stress assignment is considered non-phonemic in that the distribution of stress is predictable. CA is described as having only one primary stress in every content word and no secondary stress[39] is reported (Al-Ani 1970, McCarthy 1979a, 1979b, Abu-Salim 1982, Halle and Vergnaud 1987, Hayes 1995, Al-Mohanna 2007, Watson 2011). It exhibits an unbounded stress system, allowing long sequences of unstressed syllables (McCarthy1979b, Kager 2009). The stress system in CA has straightforward and common stress rules in comparison to other languages due to its simple syllable structure inventory, and its high predictability (Hayes 2009: 284). Stress is assigned to one of the last three syllables, depending on both the weight and the position of the stressed syllable. Thus, the possible stress assignment cannot retract beyond the antepenultimate window with words consisting of more than three syllables, as in [ka.ˈli.ma.tun] ‘word’ (Angoujard 1990). The basic stress patterns of CA are given in (5.1) below:

(5.1) Stress Patterns in CA (Watson 2011: 14)

1. Stress falls on superheavy syllables (CVVC, CVCC, CV:G), as in [ki.ˈta:b] ‘book’, [da.ˈrast] ‘I/you (mas. sg.) studied’, and [ˈma:d:] ‘stretching (mas. sg.)’ (note that CV:G syllable here is limited to monosyllabic words in CA).
2. Otherwise, stress falls on the rightmost non-final heavy syllable (CVV, CVC, CV:G) in which stress is limited to the antepenultimate syllable, as in [da.ˈras.na] ‘we learnt’, [ˈmak.ta.bah] ‘library, [sˤa:.ˈbu:.nun] ‘soap (nom.)’, and [ˈʤa:d.dun] ‘serious (mas. pl. nom.).
3. Otherwise, in the absence of a heavy or a superheavy syllable, stress falls on the antepenult CV syllable, as in [ˈda.ra.sa] ‘he studied’.

For foot construction purposes in CA, the direction of footing is parsed from left-to-right, and feet are moraic trochees (head-initial). Likewise, feet are minimally binary and degenerate feet are absolutely banned. Degenerate feet fail to qualify the bimoraicity condition in which a foot should be minimally bimoraic or maximally disyllabic. To demonstrate this, a word consisting

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[39] A syllable with secondary stress is not as much louder and longer as a syllable with primary stress. For instance, in English, the word ‘entertainment’ bears two degrees of stress. That is, a main stress falls on the penult and a secondary stress falls on the initial syllable [ˌɛn.tə.ˈteɪn.mənt] (see Burzio and Luigi 1994).

of three light syllables LLL or one heavy followed by one light syllable HL, the last light syllable is unparsed due to the outright ban on degenerate feet as (ˈLL)L and (ˈH)L, respectively. Bear in mind that languages are varied in how they treat degenerate feet. Hayes (1995) suggested a parameter determining the degree of prohibition on such feet. Three levels of prohibition are assumed: strong, weak, and non-prohibition. The definition for each level is given below in (5.2):

(5.2) Prohibition Levels on Degenerate Feet (Hayes 1995: 87)

a. ‘Strong Prohibition:
   Forming degenerate feet is absolutely disallowed.

b. Weak Prohibition:
   allowed only in strong position, i.e., when dominated by another grid mark.

c. Non-prohibition
   Forming degenerate feet is freely allowed[40]’.

NNA imposes a robust ban on degenerate feet for two reasons. First, Hayes (1995) posited that there is direct connection between the minimum word size and the way we treat degenerate feet. Thus, if a language prohibits a monomoraic syllable to construct a foot on its own and requires a foot to be minimally bimoraic, it is more likely to ban degenerate feet. For NNA, content words are minimally bimoraic. This is evidenced by the fact that words containing a single CV syllable are confined to only function words in NNA, such as [la] ‘no’. Second, the absolute ban on degenerate feet is motivated by the principle of End Rule Right (ERR), which assigns stress to the rightmost visible foot in the word. On that account, if foot construction restrictions permit degenerate feet, the stress is assigned incorrectly to a degenerate foot by ERR, as in the word *(ʕa.tˁi)(ˈni) ‘give (fem.) me!’ rather than (ˈʕa.tˁi)ni.

According to Al-Jarrah (2002), modern Arabic dialects share the most general stress patterns that control the distribution of stressed and unstressed syllables. One of the similarities is stressing superheavy syllables in a word-final position and heavy syllables in other word positions. Nevertheless, Bedouin dialects, a category to which NNA belongs, are subject to certain differences in terms of stress assignment rules compared to other urban Arabic varieties (cf. Irshied 1984, Sakarna 1999). More to the point, contemporary Arabic dialects show some differences regarding the primary stress assignment, which can be classified into two main

[40] Hayes (1995) argued that there is lack of robust evidence on this level of prohibition.

issues. First, the limitation of stress placement to a three-syllable window or more, as in Egyptian, Jordanian, and Syrian Arabic where the stress placement does not regress beyond the antepenultimate syllable (McCarthy 1979b, Adra 1999, Mashaqba and Huneety 2018). In contrast, in some Arabic varieties, stress is assigned up to the pre-antepenult syllable in polysyllabic words, as found in Palestinian, Iraqi, and a Southern Saudi Arabic (Kenstowicz and Abdul-Karim 1980, Abu-Salim 1982, Hayes 1995, Al-Abdely 2011, Alahmari 2018). Second, some Arabic dialects treat final consonants as extrametrical, as in Cairene, whereas in others like Palestinian and Damascene Arabic, the concept of extrametricality is assigned only to the final syllable in a phonological word (McCarthy 1981, Hayes 1995).

We now turn to the subsequent section (5.3), which devotes to offer an overview of the stress system of content words and then to provide data of various stress patterns based on syllable weight in the understudied dialect.

5.3 Stress Assignment in NNA

NNA is identified as a quantity-sensitive dialect in which syllable weight and position play crucial roles in determining the location of the potential stressed syllable within content words. That is, the distribution of stress is non-phonemic, and thus it is predictable. Therefore, stress assignment is rule-governed in the dialect. More importantly, the main stress falls on one of the last three syllables in a word from the right edge: ultimate, penultimate, or antepenultimate stress. This means that the main stress is limited only to a three-syllable window, and a pre-antepenultimate syllable never attracts stress in NNA. Remember that syllable weight is measured by a basic timing unit called 'mora'. NNA realises three weights of syllable: light, heavy, and superheavy. Following Moraic Theory (Hyman 1985, McCarthy and Prince 1986, Hayes 1989, Davis 2011) a light syllable assigns a single mora (monomoraic), a heavy syllable assigns two moras (bimoraic), and a superheavy syllable assigns a bimoraic syllable and an extra metrical consonant (extrasyllabic consonant) (cf. Watson 1999, 2002, 2011, Al-Mohanna 2004). Geminates are always moraic, whilst coda consonants bear a mora only through the Weight-By-Position (WBP) principle in a non-final position. Thus, a final CVC syllable becomes light and consequently fails to receive stress. Onsets carry no inherent weight to the syllable (for more details on syllabic weight and its distribution and how we treat superheavy syllables to eschew trimoraicity, see Chapter Three). The remainder of this section is laid out as follows. In subsection 5.3.1, I present general stress patterns in monosyllabic and polysyllabic content words which consist of 1-syllable words and up to 6-syllable words. Then, subsection 5.3.2 shows how stress shift takes place in the language.

5.3.1 General Stress Patterns in NNA

This subsection is divided into two parts: stressing heavy and superheavy in monosyllabic content words as introduced in (1), and stressing light, heavy, and superheavy in polysyllabic content words as introduced in (2). Before embarking to (1) and (2), stress rules for NNA can be summed up in the following ordered algorithm:

1. Stress falls on the rightmost visible superheavy syllable within a three-syllable window (up to antepenult applies to the rest as well), such as [ˈdo:k] 'take/hold' and [ðˤa.ˈrabt] 'I hit'.
2. Otherwise, stress falls on the rightmost non-final heavy syllable, such as [mit.ˈħas.fah] 'she regretted', [ˈʔam.mi.hin] 'their (fem.) uncle', and [ʤaw.wa:.ˈla:.ta.na] 'our phones'
3. Otherwise, stress falls on the initial light syllable, such as [ˈɣa.da] 'lost' and [ˈħa.ʃa.rah] 'insect'.
4. Otherwise, stress falls on the rightmost non-final light syllable (penult) when it is flanked by light syllables, such as [dar.ri.ˈsi.tuh] 'she taught him', and [sa:.ʕi.ˈdi.tuh] 'she helped him'.

1. Monosyllabic words

Monosyllabic content words can only be either heavy or superheavy syllables, which in turn, meet the minimal word conditions. This condition requires all lexical words and feet to be minimally bimoraic or maximally disyllabic. Accordingly, the last segment of the canonical superheavy syllables CVCC, CVVC, CVVG, and CCVCC is designated as extrasyllabic in which it does not add weight to the syllable and thus it maintains the bimoraicity condition. Obviously, all monosyllabic words receive stress by their own. Consider the following stressed monosyllabic words as shown in (a) below: (L = light syllables, H = heavy syllables, S = superheavy syllables)

a. Heavy and Superheavy syllables CVG, CVVC, CVCC, CVVG, CCVCC

Syllable Form	Word	Gloss
a. ˈH	[ˈʃad:]	tighten
b. ˈS	[ˈdo:k]	take/hold
c. ˈS	[ˈtˤijn]	mud
d. ˈS	[ˈħa:d:]	sharp (mas.)
e. ˈS	[ˈkrimt]	grateful (mas.)

2. Polysyllabic words

Polysyllabic content words can be made of light, heavy, and superheavy syllables. One of the minimal word conditions is met when constructing a foot: the number of moras which is minimally bimoraic or the number of syllables which is maximally disyllabic. Remember that stress strictly falls on one of the last three syllables from the right-edge of the word, even though they are preceded by a CVG syllable. Below, we will begin with stressing light syllables and end with stressing superheavy syllables.

1. Light Syllables

Stressing light syllables in NNA can be divided into two rules. First, in disyllabic and trisyllabic words that consist of only light syllables, stress falls on the leftmost light syllable (the initial light syllable). Second, in words that contain more than three syllables, stress falls on the light penult when it is flanked by two light syllables. Final CVC syllables are counted as light (monomoraic) and the last consonant is eligible for extrametricality. Note that all light syllables (CV and CVC) fail to assign stress to a word-final position. Consider the following examples in (a) and (b), respectively:

a. CV Syllables

Syllable Form	Word	Gloss
a. ˈLL	[ˈɣa.da]	lost
b. ˈLL	[ˈga.ʕad]	sat/got up
c. ˈLLL	[ˈħa.ʃa.rah]	insect
d. HLˈLL	[ʕal.li.ˈmi.tah]	she told her
e. HLˈLL	[dar.ri.ˈsi.tuh]	she taught him
f. LHLLˈLL	[jta.ðak.ka.ru.ˈni.hin]	they are remembering them (fem.)
g. HLLˈLL	[jin.ti.χi.ˈba.ham]	he calls them for help

b. Final CVC Syllables

Syllable Form	Word	Gloss
a. ˈLL	[ˈki.tab]	he wrote
b. ˈHL	[ˈmak.tab]	office
c. ˈHL	[ˈka:.tim]	dark
d. LˈHL	[ɣa.ˈðˤa:.rah]	goblet
e. LˈHL	[ki.ˈtab.tuh]	I wrote it
f. HLˈLL	[miħ.ta.ˈra.mah]	respected (fem.)

2. Heavy Syllables

For heavy syllables, in the absence of superheavy syllables, stress falls on the rightmost non-final heavy syllable up to the antepenultimate syllable. In NNA, heavy syllables are pertinent to one of the following syllable inventories: CVC word-internally as in (2a), CVG word-internally as in (2b), and CVV word-internally as in (2c). Remember that non-final CVG syllables are treated as bimoraic (heavy) because geminates are always moraic unless they occur with superheavy syllables CVVG word-finally. Likewise, non-final CVC syllables are bimoraic (heavy) and imposed by the WBP condition which renders a non-final coda as moraic and receives stress (Hayes 1989, 1995 and Davis 2011). Consider the following examples in (a), (b), and (c), respectively:

a. Non-final CVC Syllables

Syllable Form	Word	Gloss
a. ˈHL	[ˈjab.tsi]	he cries
b. ˈHL	[ˈʔiʃ.nuħ]	why?
c. ˈHLL	[ˈʔin.sˤa.lag]	fall down
d. LˈHL	[ki.ˈtab.na]	we wrote
e. LˈHL	[ta.ˈrak.tuh]	I left him
f. HˈHL	[mit.ˈħas.fah]	she regretted
g. HˈHL	[war.ˈdat.ham]	their rose
h. LˈHLL	[ki.ˈtab.ti.lah]	I wrote to her
i. HˈHLL	[jaʃ.ˈraħ.li.na]	he is explaining to us

b. Non-final CVG Syllables

Syllable Form		Word	Gloss
a.	ˈHL	[ˈzum.man]	carry me (fem.)!
b.	ˈHL	[ˈsal.lim]	greet me (mas.)!
c.	ˈHHL	[ˈʔal.lam.ham]	he told them
d.	ˈHHL	[ˈfah.ham.na]	he explained to us
e.	ˈHLL	[ˈʔam.mi.hin]	their (fem.) uncle
f.	LˈHL	[ji.ˈʕiz.zuh]	he respects him
g.	LˈHLL	[jti.ˈsˤan.na.ʕan]	they (fem.) make something up
h.	HLˈHL	[mas.ra.ˈħij.jah]	play
i.	LHLˈHLL	[jta.na:.sˤi.ˈfan.ni.hin]	‘they (fem.) share it equally’

c. CVV Syllables

Syllable Form		Word	Gloss
a.	ˈHL	[ˈna:.di]	club
b.	ˈHL	[ˈʤa:.ruh]	his neighbour
c.	ˈHLL	[ˈbe:.ta.na]	our house
d.	LˈHL	[ʕa.ˈma:.rah]	building
e.	ˈHHL	[ˈku:.rat.hin]	their (fem.) ball
f.	ˈHHL	[ˈʕa:.lam.ham]	their (mas.) world
g.	HˈHL	[sˤil.ˈha:.mah]	bald head
h.	LHˈHL	[mi.sa:.ˈfa:.ti]	my distances
i.	HHˈHLL	[ʤaw.wa:.ˈla:.ta.na]	our phones
j.	HˈHL	[mal.ˈgu:.fah]	naughty (fem.)
k.	LLˈHL	[ka.fa.ˈra:.ti]	my tyres
l.	HHˈHL	[ʕal.maħ.ˈðˤu:.rah]	banned (fem.)

3. Superheavy Syllables

Superheavy syllables are represented as bimoraic syllables because the final consonant of such syllables is deemed as extrasyllabic word-finally, and it shares a mora with the preceding vowel word-internally. For these types of syllables, stress falls on the ultimate if it is a superheavy syllable which is confined to one of the following syllable shapes: CVCC, CCVCC as presented in (1a), and CVVC as presented in (1b). Otherwise, in the absence of final superheavy syllables, stress falls on the rightmost superheavy syllable which is confined only to one of the syllable shapes: CVVC as in (1b) and CV:G as in (1c). Moreover, in the presence of two adjacent superheavy CVVC syllables within the same word, the rightmost one receives stress. Consider the following examples in (a), (b), and (c), respectively:

a. Final CVCC and CCVCC Syllables

Syllable Form	Word	Gloss
a. LˈS	[da.ˈrast]	I studied
b. LˈS	[ðˤa.ˈrabt]	I hit
c. HˈS	[ʔar.ˈsalt]	I sent
d. HˈS	[sa.ˈʕalt]	I asked
e. HLˈS	[ʔis.ti.ˈdart]	I go around
f. HLˈS	[ʔin.ʕa.ˈraft]	I became known
g. LHˈS	[ti.kah.ˈrabt]	I got shocked
h. HˈS	[ʔin.ˈtχibt]	I was elected

b. CVVC Syllables

Syllable Form	Word	Gloss
a. SˈS	[ta:k.ˈli:n]	you (fem. sg.) are eating
b. ˈSL	[ˈtˤa:l.bah]	female student
c. ˈSLL	[ˈra:ħ.li.na]	he went to us
d. LˈS	[ði.ˈba:n]	opportunist
e. LˈS	[ħa.ˈli:m]	A meek person
f. LLˈS	[ka.fa.ˈra:t]	wheels
g. HSˈS	[mit.fa:h.ˈmi:n]	they understand each other
h. LHˈS	[ti.hag.ˈwi:t]	I had hoped
i. LˈS	[maʃ.ˈɣo:l]	busy/occupied
j. HLˈS	[mis.ti.ˈʃa:r]	consultant
k. HLLˈS	[mis.ti.fi.ˈdi:n]	beneficiaries (mas.)
l. HHLˈS	[jta:.ʕa:.ti.ˈbu:n]	they blame each other

c. Non-final CVVG Syllables

Syllable Form	Word	Gloss
a. ˈSL	[ˈħa:d.dah]	sharp (fem. sg.)
b. ˈSL	[ˈha:m.mah]	important (fem.)
c. ˈSHL	[ˈðˤa:r.rat.ham]	she hurt them
d. ˈSHL	[ˈsˤa:d.dat.na]	she repulsed us
e. HˈSL	[ʔal.ˈdʒa:d.dah]	the road

To sum up so far, NNA is a quantity-sensitive dialect because syllable weight and position impact the location of the main stress. In general, stress assignment in NNA has a tendency to assign stress to the rightmost heavy and superheavy syllables, except for words containing only light syllables up to three syllables, stress assigns to the leftmost light syllable. Words that contain more than three syllables, stress falls on the light penult when it is flanked by two light syllables. It should be pointed out that stress assignment is governed by a three-syllable window restriction, rendering only the last three syllables from the right qualified for stress. Before presenting the stress patterns, it should be emphasised that CVVC, CVCC, CVV, non-final CVG and CVC syllables are bimoraic, whereas CV and final CVC syllables are monomoraic.

5.3.2 Stress Shift

Stress shift is common cross Arabic dialects. In NNA, stress assignment may shift from one syllable to another within a three-syllable window effect via morpheme concatenation forms (affixes) or some phonological processes. To illustrate how stress shift takes place in the dialect, I will introduce some cases of stress shift that occur in words after derived environments or some other morphological/phonological processes. Consider the following stress shift examples as in (5.3) below:

(5.3) Stress Shift After Derived Environments

1. **Vowel Lengthening in Final CV After Suffixation**
   a. /daʕa/ → [ˈda.ʕa] ‘he called’
   b. /daʕa-ham/ → [da.ˈʕa:.ham] ‘he called them’

   c. /ʔaχu/ → [ˈʔa.χu] ‘brother
   d. /ʔaχu-k/ → [ʔa.ˈχu:k] ‘your brother’

It should be observed from the data in (1) that a base form ends with a short vowel which undergoes vowel lengthening after suffixation. Watson (2002) posited that word-final vowels are underlyingly short and subject to lengthening under the influence of morphology. I follow this analysis because word-final long vowels do not surface in any form in the dialect. Thus, the only exception to this generalisation is a vowel lengthening when a stem is attached to a suffix. This phonological process causes a stress shift such as the underlying form [ˈda.ʕa] assigns stress to the initial light syllable and the derived form in (b) assigns stress to the penultimate heavy syllable after suffixation via vowel lengthening yielding [da.ˈʕa:.ham].

2. **The Effect of Definite Article ʔal- and Present Prefixes on Final CVG**
    a. /ʕam:/ → [ˈʕam:] ‘uncle’
    b. /ʔal-ʕam:/ → [ˈʔal-ʕam] ‘the uncle’

    c. /ħiʤ:/ → [ˈħiʤ:] ‘pilgrimage’
    d. /ʔal-ħiʤ:/ → [ˈʔal.ħiʤ] ‘the pilgrimage’

    e. /mad:/ → [ˈmad:] ‘spread’
    f. /ji-mid:/ → [ˈji.mid] ‘he spreads’

    g. /rad:/ → [ˈrad:] ‘respond’
    h. /ti-rid:/ → [ˈti.rid] ‘she responds’

It is already mentioned that geminates never occur word-finally in derived environments. We have attested a word-final geminate in two contexts: when a nominal stem (CVG) preceded by one of the prefixes: the definite article ʔal-, ji-, or -t. the data sets in (2) exhibit that if a nominal stem (CVG) is attached to the definite article -ʔal or other prefixations, a word-final geminate is prone to degemination yielding a stress shift in morphologically complex words in the language. For instance, the nominal stem [ˈʕam:] assigns stress to an ultimate prior to suffixation, whereas if the definite article is attached to the nominal stem as prefix [ˈʔal-ʕam], stress is shifted to the initial syllable after morpheme concatenation. Consequently, the final CVC syllable is treated as light due to consonant extrametricality which never attracts stress in the language.

3. The Effect of Plural Forms

a. /muʕallim/ → [mu.ˈʕal.lim] ‘teacher’

b. / muʕallim-i:n/ → [mu.ʕal.li.ˈmi:n] ‘teachers’

c. /mhandis/ → [ˈmhan.dis] ‘engineer’

d. / mhandis-i:n/ → [mhan.di.ˈsi:n] ‘engineers’

e. /sajja:rah/ → [saj.ˈja:.rah] ‘car’

f. /saj.ja:.rah-a:t/ → [saj.ja:.ˈra:t] ‘cars’

g. /mi.tˤa:r/ → [mi.ˈtˤa:r] ‘airport’

h. /mi.tˤa:r-a:t/ → [mi.tˤa:.ˈra:t] ‘airports’

i. /nahar/ → [ˈna.har] ‘river’

j. /nahar/ → [ʔan.ˈha:r] ‘rivers’

k. /maktab/ → [ˈmak.tab] ‘office’

l. /maktab/ → [mi.ˈka:.tib] ‘offices’

All the previous examples in (3) present nominal stems and their plural forms after suffixation. To briefly illustrate, we have observed three types of plural forms in NNA: masculine sound plural, feminine sound plural, and broken plural[41]. The data sets above involve all the plural types in the dialect. Examples (a-d) involve singular noun forms and their masculine sound plural forms where the morpheme *-i:n* is suffixed to the nouns to indicate plurality. The stress is shifted from penultimate to ultimate after morphological concatenation as in [mu.ˈʕal.lim] ‘teacher’ → [mu.ʕal.li.ˈmi:n] ‘teachers’. Examples (e-h) involve singular noun forms and their feminine sound plural forms where the morpheme *-a:t* is suffixed to the nouns. The stress is assigned to ultimate prior to suffixation as in [mi.ˈtˤa:r] ‘airport’ and then shifted to ultimate after suffixation as in [mi.tˤa:.ˈra:t] ‘airports’. Finally, examples (i-l) involve nouns which are pluralised by changing the noun’s structure by adding affixes because it is regarded as irregular plural in Arabic including NNA. The initial syllable attracts stress, and then it is shifted to ultimate after suffixation as in [ˈna.har] ‘river’ → [ʔan.ˈha:r] ‘rivers’.

[41] Broken plural has more than 13 patterns because it is considered as irregular in Arabic including NNA. So, the question of how broken plural functions in the dialect along with the details of other plural types are beyond the scope of this thesis since the main focus is on phonological generalisations not on morphological processes.

4. **Stress Shift with Possessive Forms**

- 1st person plural possessive suffix *-na*

1. /mu.da.ra/ ‘managers’ → [ˈmu.da.ra]
2. /mu.da.ra-na/ ‘our managers’ → [mu.da.ˈra:.na]

- 2nd person plural possessive suffix

3. /madʒlis/ ‘guest room’ [ˈmadʒ.lis]
4. /madʒlis-kam/ ‘your guest room’ [madʒ.ˈlis.kam]

- 3rd person plural possessive suffix

5. /galam/ ‘pen’ [ˈga.lam]
6. /galam-hin/ ‘their (fem.) pen’ [ga.ˈlam.hin]

It should be noted that stress is shifted in all the suffixed words in which it mainly coincides with the NNA stress assignment patterns outlined earlier in the chapter. For example, when the suffix *-na* is attached to a noun, stress shifts to the rightmost heavy syllable as in [ˈmu.da.ra] ‘mangers’ → [mu.da.ˈra:.na] ‘our managers’. Before winding up this section, it should be highlighted that stress shift does not necessarily occur with all derived forms. That is to say, some suffixes do not affect the stress location in a given word, such as the 1st person singular possessive suffix marker -i, and the 2nd person singular possessive suffix -ak or -its, and the 3rd person singular possessive suffix marker -ah or -uh, as in [ˈmak.tab] ‘office’ → [ˈmak.ti.bi] ‘my office’, [ˈmak.ti.bak] ‘your office’ and [ˈmak.ti.bah] ‘her office’. Finally, the stress patterns in the presented cases are analysed in the subsequent sections under the principles of Metrical Stress Theory (Hayes 1995) and then the framework of Optimality Theory.

5.4 Foot Construction

One or more syllables are parsed into feet in which only one syllable is designated as the prominent head within a stress domain. Under a foot-based theory of stress, every content word must contain at least one foot. That is, a foot is formed from maximally disyllabic yielding two light syllables or minimally bimoraic yielding one heavy syllable (Hayes 1995). Cross-linguistically, the foot inventory contains three essential types: (1) a syllabic trochee foot has two light syllables in which stress is initial in the foot (head-initial), (2) a moraic trochee foot has a single bimoraic heavy syllable in which stress is initial in the foot (head-initial), (3) an iambic foot has a disyllabic foot in which stress is final (head-final). In NNA, the foot inventory is trochaic: a moraic trochee foot containing two monomoraic light syllables (ˈLL), and a moraic trochee foot containing single bimoraic heavy syllable (ˈH).

The following general accounts on the stress system of NNA are defined within certain parameters and rules of foot construction in the dialect (Hayes 1995). Foot parsing is built from left to right with the effect of End Rule Right (ERR). Feet are always binary, either under moraic or syllabic analysis, and degenerate feet are absolutely prohibited because unparsed monomoraic syllables are invisible to stress rules and fail to form a foot on their own in NNA. The directionality of footing can affect stress assignment. To clarify, in an odd number of light syllables LLL, the parsing of a moraic trochee foot raises questions about directionality, i.e., right-to-left L(ˈLL) or left-to-right (ˈLL)L, and how to treat the unparsed single monomoraic light syllable after foot construction. To answer these questions, let us attest the foot construction of the following example consisting of three light syllables [ˈħa.ʃa.ra⟨h⟩] 'insect' with consonant extrametricality represented by angle brackets ⟨ ⟩, as sketched below in (5.4). Note that parentheses ( ) indicate a foot, the symbol (x) indicates stressed elements, the bullet (•) indicates unstressed elements, a macron (‾) indicates a bimoraic syllable, and a breve (˘) indicates a monomoraic syllable.

(5.4) LLH → (LL)L

(x)	Prosodic Word Level (ERR)
(x •)	Foot Level
˘ ˘ ˘	Moraic Level
ħ a ʃ a r a ⟨h⟩	Segmental Level

As can be seen from (5.4), the direction of parsing starts from left to right, creating a disyllabic foot over the first two light syllables (ˈħa.ʃa) with a trochaic stress. That is to say, at the foot level, the last syllable [ra] is left over at the end of the parse since a single light syllable cannot form a foot on its own due to the outright ban on degenerate feet. Clearly, this syllable cannot be parsed with the preceding constructed foot because feet are minimally binary and maximally disyllabic. Moreover, it has already been argued that a CVC syllable word-finally is treated as light, rendering the final consonant as extrametrical. To prevent footing a CVC syllable, the notion of consonant extrametricality is invoked as an explanation to provide an effective analysis of the feet maximal size restriction and to avoid stressing final CVC syllables in the dialect. Accordingly, final CVC syllables emerge as light rather than heavy and the final consonant is regarded extrametrical. For illustration, suppose that the direction of parsing is from right to left; the degenerate foot [ra] would be footed with the following syllable [ʃa], and in turn, the unparsed syllable would incorrectly attract stress *(ʃa.ˈra⟨h⟩). At the prosodic level, the ERR principle assigns stress to the head of the rightmost visible foot yielding (ˈħa.ʃa) .

The foot parsing in (5.4) is straightforward, and it sheds further light on foot construction for other word forms containing only two light syllables. Now, it is essential to examine the notion of consonant extramtericality with disyllabic words consisting of a light syllable followed by one of the following syllables: CVC or CVG. As mentioned previously, a final CVC syllable is treated as light by the enforcement of WBP and a final CVG syllable undergoes degemination in morphologically complex words in the language. Consider the following metrical parsing to illustrate how /kitab/ 'he wrote' → [ˈki.tab] and /jimid:/ 'he extends' → [ˈji.mid] are footed after weight reduction and degemination are applied, as depicted in (5.5):

(5.5) LH → (LL)

a.	(x)	Prosodic Word Level (ERR)
	(x •)	Foot Level
	˘ ˘	Moraic Level
	k i t a ⟨b⟩	Segmental Level
b.	(x)	Prosodic Word Level (ERR)
	(x •)	Foot Level
	˘ ˘	Moraic Level
	j i m i d ⟨d⟩	Segmental Level

The metrical representations in (5.5 a-b) denote that the directionality of foot parsing is constructed from left to right, creating a disyllabic foot over the first two light syllables with a trochaic stress assignment. Thus, the direction of foot parsing and the stress placement in (a) and (b) support the idea that foot is trochaic (left-headed) in the dialect. In both representations, the last segments are designated as extrametrical, rendering the final CVC syllable in (a) and the final CVG syllable in (b) light, where the final C-slot of the geminate totally disappears.

Hayes (1981, 1995) argued that the application of extrametricality is restricted by certain conditions. The first condition is the constituency in which extrametricality may apply at various levels in the prosodic hierarchy, segments, and at higher levels. The definition of constituency is given in (5.6):

(5.6) Constituency Condition (Hayes 1995: 57)

> Only constituents (segment, syllable, foot, phonological word, affix) may be marked as extrametrical.

The second condition is peripherality in which extrametricality is proposed to be employed at the left or right edge of the prosodic word. In NNA, foot extrametricality is supported by the fact that stress never lodges on a foot aligned with the right edge of the word. The definition of peripherality is given in (5.7):

(5.7) Peripherality Condition (Hayes 1995: 57)

> A constituent may be extrametrical only if it is at a designated edge (left or right) of its domain.

Peripherality controls the occurrence of extrametricality to the edges of a domain in which edge markedness is only applied at the right edge in the dialect. This restriction is laid out in (5.8) below:

(5.8) Edge Markedness Condition (Hayes 1995: 57)

> The unmarked edge for extrametricality is the right edge.

Under traditional metrical theory (Hayes 1995), the notion of extrametricality involves a foot, a device making the right edge of a foot completely invisible to stress assignment. According to Hayes, foot extrametricality is provoked as a result of a stress clash between the final foot's head and the preceding syllable. However, foot extrametricality is problematic for cases where the main stress is assigned to a light penult with quadrisyllabic words, such as [dar.ri.ˈsi.tuh] ‘she taught him’ and [miħ.ta.ˈra.mah] ‘respected (fem.)’. It should be clear at this point that foot extrametricality cannot be applied to the second foot due to the nonexhaustivity condition, which ensures that ‘an extrametricality rule is blocked if it would render the entire domain of the stress rules extrametrical’ (Hayes 1995: 58). Furthermore, if we construct binary feet over the initial heavy syllable followed by two light syllables (dar)(ˈri.si) and the last syllable is skipped over unparsed with consonant extrametrical tu⟨h⟩, we would predict the wrong stress pattern since the stress system in NNA is trochaic and retraction is limited to the antepenultimate. This issue must be resolved in a way that maintains the stress pattern with trochaic feet and up to antepenultimate in NNA. Hayes (1995) proposed a ternary alternation that is a result of a device known as Weak Local Parsing. This device ensures that a light syllable is skipped during parsing in order to separate feet from each other, satisfying the rhythm constraint *CLASH. On the other hand, binary alternations draw from Strong Local Parsing which aims to keep feet next to each other. Many researchers support the idea that metrical structure does not necessarily exhaust the entire string of syllables (Watson 2011: 9). Hence, Hayes (1995) assumed that after foot structural configuration has been established, light syllables are either skipped unfooted or a degenerate foot is created. The parameter of foot parsing locality distinguishes between two different types of foot parsing: strong and weak, as expressed in (5.9):

(5.9) Foot Parsing Locality Parameter (Hayes 1995: 308)

a. Strong Local Parsing:

When a foot has been constructed, align the window for further parsing at the next unfooted syllable. (unmarked value of the parameter)

b. Weak Local Parsing:

When a foot has been constructed, align the window for further parsing by skipping over / ˘/, where possible. (marked value of the parameter)

Hayes (1995) employed the parameter of weak local parsing in many languages, including Estonian, Sentani, a variety of Arabic called Bani-Hassan, and recently in Southwestern Saudi Arabic by (Alahmari 2018), for the purpose of attesting ternary alternations. An example of ternary stress system is sketched in (5.10) below, which adopts weak local parsing in Bani-Hassan for the word [ʕal.la.ˈma.tuh] ‘she taught him’:

(5.10) Weak Local Parsing in Bani-Hassan (Hayes 1995: 366)

a.	(x)	Prosodic Word Level
	(x) (x •)	Foot Level
	‒ ˘ ˘ ˘	Moraic Level
	ʕ a l l a m a t u ⟨h⟩	Segmental Level

Under Hayes's theory, it should be clear that the device of weak local parsing is correlated with the notion of nonexhaustive foot parsing. After applying this device, stress is assigned correctly in line with the stress patterns in the language. Bearing in mind that leaving light syllables unparsed is not always the case. To demonstrate, I assume that a metrical foot consisting of a binary foot followed by a single light syllable at the end of the domain, rendering the light syllable unfooted due to the ban on degenerate feet in NNA. However, this view cannot be realised when two unstressed light syllables are left over unbracketed at the end of the domain, thus, foot configuration needs to be reconstructed to those syllables, creating a disyllabic foot by means of Persistent Footing. This principle is suggested by Hayes (1995) which is expressed in (5.11) below:

(5.11) Persistent Footing (Hayes 1995: 115)

a. Single stray syllables are adjoined to existing feet if the result is well formed.

b. Otherwise, sequences of stray syllables may be converted into feet.

Generally, the principles presented so far, consonant extrametricality, weak local parsing, and persistent footing, can account for the most general stress patterns in NNA. Consider the following representations of HL [ˈka:.tim] 'dark', HLLL [dar.ri.ˈsi.tuh] 'she taught him', and HLHL [mas.ra.ˈħij.jah] 'play', respectively, as shown in (5.12):

(5.12) HH → (H)L, HLLH → (H)L(LL), HLHH → (H)L(H)L

```
a.   (  x          )                  Prosodic Word Level (ERR)
      (x)                             Foot Level
       –    ˘                         Moraic Level
     k  a:   t  i  ⟨m⟩                Segmental Level

b.   (            x          )        Prosodic Word Level
       (x)        (x      •)          Foot Level
        –     ˘     ˘    ˘            Moraic Level
      d  a  r   r  i   s  i   t  u  ⟨h⟩   Segmental Level

c.   (             x            )     Prosodic Word Level (ERR)
       (x)          (x)               Foot Level
        –      ˘     –      ˘         Moraic Level
      m  a  s   r  a   ħ  i  j   j  a  ⟨h⟩   Segmental Level
```

The metrical representation in (a) shows that a CVC syllable in a word-final position is treated as light because it undergoes weight reduction as the last consonant is regarded as extrametrical. Thus, the word [ka:.tim] has a single foot constructed over the initial heavy syllable (ka:), which receives stress. The rightmost consonant ⟨m⟩ of the second syllable is invisible to stress assignment through extrametricality, rendering the final CVC identical in weight to CV syllables (Hayes 1995). As a result, the remaining part of the second syllable [ti] is left unparsed due to the strong prohibition on degenerate feet in the language.

In (b), the form contains an initial heavy syllable followed by three light syllables in which the final light syllable undergoes weight reduction by treating the rightmost consonant as extrametrical. A single foot is constructed over the heavy syllable (dar). The leftmost light syllable [ri] is skipped over by the effect of weak local parsing. After skipping the second syllable, persistent footing resumes to scan further along the parse to create a suitable foot. As a result, a disyllabic foot is constructed over the last two light syllables in which the final syllable undergoes weight reduction, rendering the last consonant ⟨h⟩ extrametrical. As the antepenultimate is skipped over through weak local parsing, we obtain a disyllabic trochee in which the light penultimate is the eligible stress bearer. Note here that the heavy CVG syllable (dar:) does not attract stress due to the three-syllable window restriction.

In (c), a foot is parsed over the initial heavy syllable. The following light syllable [ra] is skipped over due to the influence of weak local parsing. Thereafter, another foot is constructed over the heavy syllable (ħij) and the last syllable is left unfooted. Note that the persistent footing strategy is inapplicable to this metrical structure because one final stray light syllable cannot be further converted to a foot due to the absolute ban on degenerate feet. Hence, ERR assigns stress to the rightmost visible foot (ħij).

It should be noted that the weak local parsing principle is only applicable to light syllables. That is, bimoraic syllables cannot be left unparsed in the language. Also, weak local parsing is not confined only to internal light syllables in the parse but involves initial light syllables as well. Thus, initial light syllables can be skipped over when they do not meet the binary condition. This process can be achieved by the principle proposed by Hayes (1995), known as Priority Clause, which is expressed in (5.13) below:

(5.13) Priority Clause (Hayes 1995: 95)

> If at any stage in foot parsing the portion of the string being scanned would yield a degenerate foot, the parse scans further along the string to construct a proper foot where possible.

This rule implies that a light syllable is skipped by the priority clause principle because it fails to construct a proper metrical foot during parsing. Consider the following representation which exemplifies a word with an initial light syllable followed by a heavy syllable, such as [ɣa.ˈðˤa:.rah] ‘goblet’, as shown in (5.14):

(5.14) LHH → L(H)L

(x)	Prosodic Word Level (ERR)
(x)	Foot Level
˘ ¯ ˘	Moraic Level
ɣ a ðˤ a: r a ⟨h⟩	Segmental Level

In describing the foot configuration in (5.14), the representation shows that a foot is constructed over the heavy syllable (ðˤa:), whilst the initial light syllable [ɣa] is skipped over through the priority clause since a degenerate foot is forbidden in the dialect. The parse continues to scan further to construct a proper foot, but the final syllable is light under the influence of final weight reduction and the notion of extrametricality, so it is left unfooted. ERR assigns stress to the rightmost visible foot in the prosodic word.

There is one important case which should be discussed regarding stressing non-final heavy syllables before proceeding to the foot construction of superheavy syllables in NNA. Recall that stress is trochaic and always assigned to the rightmost visible foot by virtue of ERR. However, if we have a word consisting of a heavy syllable followed by two light syllables, such as [ˈʔin.sˤa.lag] 'fall down' and footed like (ˈʔin)(ˈsˤa.la)⟨g⟩, there should be a stress clash between the two adjacent head feet. To solve such a stress clash issue, consider the following metrical structure of the same word [ˈʔin.sˤa.lag] depicted in (5.15) below:

(5.15) HLH → (H)LL

(x)	Prosodic Word Level (ERR)
(x)	Foot Level
¯ ˘ ˘	Moraic Level
ʔ i n sˤ a l a ⟨g⟩	Segmental Level

By examining the metrical structure in (5.15), we noted that only one moraic trochee foot is constructed over the initial heavy syllable (ʔin). The following light syllable is skipped over by weak local parsing to avoid a stress clash, whereas the last light syllable is left unparsed because degenerate feet are prohibited. Then, stress is assigned to the rightmost visible heavy syllable by virtue of ERR. It should be highlighted that the principle of persistent footing is not applicable to this metrical structure due to the stress clash environment. Therefore, it is highly predominant for footing to solve a stress clash rather than to be persistent. This hypothetical footing motivates the notion of the principle of weak local parsing, which stipulates that feet should be kept away from each other in order to obviate the possibility of a stress clash.

Now we will examine the foot construction of words containing final and non-final superheavy syllables and how stress is assigned to those syllables in the language. Recall that only final superheavy syllables attract stress in the dialect. Likewise, a relatively rare case in Arabic and modern Arabic dialects is the presence of two adjacent superheavy syllables (mainly CVVC) within the same word. In this case, ERR assigns stress to the rightmost visible foot (superheavy syllable). Let us begin with final superheavy syllables, which attract stress word-finally. It should be noted from the previous metrical representations that the strategy of weak local parsing is applied only to light syllables. Thus, bimoraic syllables must be parsed into binary or disyllabic feet and thus cannot be skipped over under any circumstances. This is exemplified in the following metrical representations for the words [ˈdo:k] ‘take/hold’ and [ʔar.ˈsalt] ‘I sent’, as sketched in (5.16) below: (Recall that angle brackets ⟨ ⟩ denotes extrasyllabicity with only final superheavy syllables)

(5.16) S → (H), HS → (H)(H)

a.	(x)	Prosodic Word Level (ERR)
	(x)	Foot Level
	–	Moraic Level
	d o: ⟨k⟩	Segmental Level
b.	(x)	Prosodic Word Level (ERR)
	(x) (x)	Foot Level
	– –	Moraic Level
	ʔ a r s a l ⟨t⟩	Segmental Level

The metrical structure in (5.16) demonstrates that superheavy syllables attract stress in the word-final position. To clarify, in (a), the monosyllabic word constructs a moraic trochee foot over the heavy syllable (do:) and treats the final consonant as extrasyllabic ⟨k⟩. Therefore, the binary foot straightforwardly attracts stress. In (b), the parse exhibits two binary moraic trochee feet, which are constructed over the two bimoraic syllables. That is, the strategy of weak local parsing and the principle of the priority clause are inapplicable due to the lack of initial and internal light syllables. Furthermore, foot extrametricality is blocked here due to the presence of an extrasyllabic consonant at the right edge of the word. Thus, stress is assigned to the rightmost visible foot by ERR.

In the case of a word consisting of a light syllable followed by a superheavy syllable, the strategy of the priority clause is adopted in order to deprive an initial light syllable from parsing. Consider the following representation of the word [ði.ˈba:n] 'opportunist' in (5.17):

(5.17) LS → L(H)

(x)	Prosodic Word Level (ERR)
(x)	Foot Level
˘ ‒	Moraic Level
ð i b a: ⟨n⟩	Segmental Level

The metrical representation in (5.17) creates a single binary moraic trochee foot over the bimoraic syllable (ba:). The first light syllable [ði] is left unfooted through the principle of the priority clause because it cannot construct a metrical foot on its own. Foot extrametricality is blocked by the presence of an extrasyllabic consonant ⟨n⟩. Thus, ERR assigns stress to the rightmost visible foot in the parse.

As mentioned previously, when a light syllable is trapped between two bimoraic syllables, a light syllable is skipped over by the principle of weak local parsing. To demonstrate this case, consider the following metrical representation for the word [ʔis.ti.ˈdart] 'I go around' in (5.18) below:

(5.18) HLS → (H)L(H)

(x)	Prosodic Word Level (ERR)
(x) (x)	Foot Level
– ˘ –	Moraic Level
ʔ i s t i d a r ⟨t⟩	Segmental Level

The foot parsing in (5.18) builds two binary moraic trochee feet over the first syllable (ʔis) and the last syllable (dar). The internal light syllable [ti] is left over unfooted by weak local parsing. The last consonant of a superheavy syllable is regarded as extrasyllabic, which in turn allows superheavy syllables to receive the main stress, i.e., the last consonant is left unparsed; thus, it prevents the rightmost visible foot from being peripheral. ERR selects the rightmost visible foot to attract stress in the metrical structure.

In the presence of two internal light syllables in a metrical foot, we adopt the strategies of weak local parsing and the priority clause in order to skip over these syllables during parsing and to assign stress correctly to the rightmost visible heavy syllable. Note that we combine these strategies in a ternary alternation when these internal light syllables are trapped between two head feet to avoid a stress clash. To illustrate this case, consider the following metrical representation of the quadrisyllabic word [mis.ti.fi.ˈdiːn] ‘beneficiaries (mas.)’ under the analysis of the two presented strategies, as shown in (5.19) below:

(5.19) HLLS → (H)LL(H)

(x)	Prosodic Word Level (ERR)
(x) (x)	Foot Level
– ˘ ˘ –	Moraic Level
m i s t i f i d iː ⟨n⟩	Segmental Level

As can be seen from (5.19), two feet are constructed over two bimoraic syllables. The leftmost light syllable is left unfooted by weak local parsing because it appears in a forward direction immediately following a bimoraic foot. However, the rightmost light syllable is left unfooted by the priority clause because this syllable is unable to construct a foot on itself due to the ban on degenerate feet and it cannot adjoin the following syllable. The final consonant of the superheavy syllable ⟨n⟩ blocks foot extrametricality. Thus, ERR assigns stress to the rightmost visible foot.

Weak local parsing and the priority clause are inapplicable when a word consists of two light syllables followed by a heavy syllable. This case is exemplified in the following metrical representation of the word [ka.fa.ˈra:t] ‘wheels’, as shown in (5.20):

(5.20) LLS → (LL)(H)

(x)	Prosodic Word Level (ERR)
(x •) (x)	Foot Level
˘ ˘ ¯	Moraic Level
k a f a r a: ⟨t⟩	Segmental Level

It should be clear that two moraic trochee feet are constructed. The first disyllabic foot is constructed over the two light syllables. The second binary foot is constructed over the bimoraic syllable. The last consonant is considered extrasyllabic, which blocks foot extrametricality and permits superheavy syllables (prosodically bimoraic) to receive the main stress. In this case, it can be generalised that in the presence of a final superheavy syllable preceded by two light syllables (disyllabic foot) in the language, stress is always attracted to the rightmost visible binary foot by ERR.

Now we will examine the stress placement when only two adjacent superheavy syllables are presented within the same metrical structure. Recall that CVVC and CVVG are the only superheavy syllables surfacing word-internally in the language. To avoid trimoraicity, we propose that the last segment shares a mora with the preceding vowel (recall Mora Sharing Principle, Watson 2007). In this case, stress is placed according to the effect of ERR, regardless the presence of two superheavy syllables within the same word. Consider the following foot representation of the word [ta:k.ˈli:n] ‘you (fem. sg.) are eating’ in (5.21) below:

(5.21) SS → (H)(H)

(x)	Prosodic Word Level (ERR)
(x) (x)	Foot Level
– –	Moraic Level
t a: k l i: ⟨n⟩	Segmental Level

As shown in (5.21), two binary feet are constructed over two bimoraic syllables. The last consonant of the second syllable is considered extrasyllabic, and thus it blocks foot extrametricality. Stress is then assigned to the rightmost foot by ERR. It should be noted that weak local parsing and the priority clause are unable to skip over any syllable due to the lack of light syllables in the word.

After discussing foot construction of final superheavy syllables, let us now turn to the discussion of foot construction of non-final superheavy syllables. Consider the following metrical parsing for the forms [ˈtˤa:l.bah] 'female student' and [ʔal.ˈʤa:d.dah] 'the road', as shown in (5.22):

(5.22) SH → (H)L, HSH → (H)(H)L

a.	(x)	Prosodic Word Level (ERR)
	(x)	Foot Level
	– ˘	Moraic Level
	tˤ a: l b a ⟨h⟩	Segmental Level
b.	(x)	Prosodic Word Level (ERR)
	(x) (x)	Foot Level
	– – ˘	Moraic Level
	ʔ a l ʤ a: d d a ⟨h⟩	Segmental Level

All the representations above assign stress to non-final superheavy syllables. To demonstrate, in (a), a single binary foot is constructed over the initial heavy syllable (tˤa:), and the final consonant shares a mora with the preceding vowel, maintaining the bimoraicity status. The following light syllable is left unfooted because degenerate feet are banned in the language and the last consonant is deemed extrametrical. Therefore, stress is assigned to the rightmost visible heavy syllable by virtue of ERR. In (b), two binary feet are constructed over two bimoraic syllables. The following light syllable is left unparsed, and the last consonant is deemed extrametrical. ERR then assigns stress to the rightmost visible bimoraic syllable.

What is clear from the general stress patterns presented thus far is that the principle of ERR assigns stress to the rightmost non-final visible foot in a given word. Nonetheless, there are situations where the rightmost visible foot does not attract stress. These situations are observed when a geminate or a long vowel appears in the presence of other internal CVC syllables in the word. Specifically, a binary syllable contains the first leg of a geminate consonant CVG/CVVG, or a long vowel CVV always attracts stress, no matter where it is positioned and footed in the word. Examples of non-final CVG, CVVG, and CVV syllables followed by a non-final CVC syllable are repeated below for convenience, as is shown in (5.23):

(5.23) Non-final CVG, CVVG, CVV, and CVC Syllables

a. [ˈðˤa:r.rat.ham]	she hurt them
b. [ˈsˤa:d.dat.na]	she repulsed us
c. [ˈʔal.lam.ham]	he told them
d. [ˈfah.ham.na]	he explained to us
e. [ˈku:.rat.hin]	their (fem.) ball
f. [ˈʕa:.lam.ham]	their world

It should be noted that a geminate occurs in heterosyllabic contexts, where the first part of a geminate[42] often bears stress in the language. As presented earlier, medial superheavy CVVG and CVVC syllables are considered heavy and prosodically behave like CVV syllables in terms of syllable weight, where final segments share a mora with the rightmost vowel to retain the

[42] This case cannot be generalised as a rule in the dialect where a syllable that consists of the first leg of a geminate receives stress in the absence of a superheavy syllable. However, a CVG syllable does not attract stress if it is only followed by a CVV syllable. In this situation, ERR assigns stress to the rightmost visible foot.

bimoraicity condition (Watson 2002: 103). Under Moraic Theory, non-final CVC syllables become heavy by assigning a mora to coda consonants through Weight-By-Position (WBP). In stress assignment, however, non-final CVC syllables fail to bear stress when they are preceded by CVG, CVVG, or CVV syllables, as seen in the data presented above (5.23). Hence, non-final CVC syllables assign stress only when geminate consonants or long vowels are absent in the word (see the examples above in 2a).

I have already reported that in the presence of two adjacent superheavy CVVC syllables within the same word, ERR assigns stress to the rightmost visible foot in the parse. This explanation implies that the rightmost CVVC syllables always attract stress in the language. The same holds true for the occurrence of more than one prominent syllable within the same word; stress is assigned to the rightmost CVG/CVV syllables, including final superheavy CVVC syllables, which always attract stress in the language. This case is exemplified in (5.24) below:

(5.24) CVG, CVV, and CVVC Sequences

a. [sidʒ.ˈdʒa:.dah]	mat
b. [sidʒ.dʒa:.ˈda:t]	mats
c. [ɣas.ˈsa:.lah]	washer
d. [ɣas.sa:.ˈla:t]	washers

Generally speaking, geminates and long vowels have an impact on stress assignment in NNA. This view is also supported by Watson (2002) in relation to Sanˈani Arabic and Alahmari (2018) in relation to a Southwestern Saudi Arabic dialect, where both internal CVG and CVV syllables attract stress over an internal CVC syllable in a prosodic word. This impact does not adhere to the general stress analysis, whereby stress is always attracted to the rightmost visible foot by ERR. However, it has been observed that the proposed analysis will not predict the correct stress pattern in cases involving a CVG or CVV syllable followed by a non-final CVC syllable within the same word in the dialect. For the purpose of unifying our stress analysis, we should first take into account the prosodic differences between a CVG and CVV in comparison to a non-final CVC syllable. Within the realm of Moraic Theory, stress placement is based on the moraic weight of the syllable. This poses a relevant typological question: are CVV/CVG syllables and non-final CVC syllables prosodically identical? To answer this question, I follow

Morén (1999, 2003) in assuming that syllable weight stems from two essential sources: distinctive and coerced. First, distinctive weight is attributed to an underlyingly distinct moraic structure that occurs on the surface; for example, geminate consonants would have distinctive weight compared to singleton consonants. Second, coerced weight appears when a non-moraic segment surfaces as moraic in certain phonological contexts; for example, coda consonants are forced to be moraic by Weight-By-Position. Thus, the distinction between distinctive and coerced weight provides a compelling analysis for the asymmetrical prosodic weight of non-final CVC syllables in contrast to CVG/CVV syllables. On this basis, CVG/CVV syllables are inherently bimoraic, whereas a non-final CVC syllable is inherently monomoraic because its coda assigns mora only through Weight-By-Position.

To account for such asymmetry instances, we should rely on what is called 'the prominence of the syllable', which cannot be represented with moraic structure, in order to distinguish various weight degrees (Davis 1988, Prince and Smolensky 1993, Hayes 1995, Watson 2002). Based on this, stress is assigned according to multiple weight hierarchies rather than moraic structure. Hayes (1995: 271) posited that syllable weight should not be treated only as a single phenomenon, but it should be seen from two possible perspectives. First, weight can be viewed as an abstract characterisation of quantity, i.e., monomoraic vs. bimoraic. Second, weight can be viewed as a reference to prominence or perceptual salience, such as considering certain syllables as sounding louder and then receiving prominence in contrast to others in order to account for intrinsic phonological stress rules. The representation of syllable prominence has been proposed by Everette and Everette (1984), Everette (1988), and Davis (1989). This representation constitutes an extra grid mark that is designated to the more prominent syllable to represent the stressed syllable of the word with End Rule (leftmost or rightmost). Hayes (1995) asserted that stress assignment rules refer to prominence grids but not to foot construction under prominence theory in certain cases. The prominence grid is a temporary computational device but not a permanent merit of a metrically-based grid. He assumed a rational prominence theory as a temporary device formed from prominence grids with asterisks presented in an individual plane at the lower layer. This device is called Prominence Projection, which produces different weight degrees in a language assigning stress based on prominence. In cases where stress may not fall on the rightmost foot, i.e., two adjacent heavy heads and the leftmost foot is stressed, Hayes proposed the prominence grid that aims at distinguishing between heavy syllables in terms of their prominence, as laid out in (5.25):

(5.25) Prominence Projection (Hayes 1995: 284)

Project a prominence grid as follows:

**: heavy syllables

*: light syllables

End Rule is then applied to derive the correct stress. In cases of distinguishing between the syllable weight of a CVG/CVV and a non-final CVC, I will adopt Watson's (2002) prominence grid to account for the effect of geminates and long vowels in the stress system of NNA compared to non-final CVC syllables, as portrayed in (5.26):

(5.26) Prominence Projection (Watson 2002: 112)

Project a prominence grid as follows:

**: heavy syllables (CVG/CVV)

*: light syllables (CV/CVC)

The prominence projection in (5.26) is based on Hayes (1995: 284) in order to account for stress assignment in San'ani Arabic. A syllable with a geminate or a long vowel is considered as heavy, and then an extra grid mark is added to indicate its prominence. CV and CVC syllables are considered as light and thus they do not receive the prominence grid. End Rule is then applied to derive the correct stress. Under this projection, I consider non-final CVC syllables as light only in the presence of CVG and CVV syllables within the same word. Consider the following derivation for the word [ˈʔal.lam.ham] 'he told them' in (5.27), which illustrates the crucial role of the prominence projection grid in deriving the correct stress placement, as shown below:

(5.27) HHH → (H)(H)L

a. Foot construction

```
(    (x)     (x)                 )
      –        –          ˘
   ʔ a l   l a m   h a ⟨m⟩
```

b. Projection of prominence grid, ERR

```
(     x                        )
   (x)     (x)
    –        –         ˘
  ʔ a l   l a m   h a  ⟨m⟩
    *        *
    *
```

The metrical structure in (a) constructs two binary moraic trochee feet over two bimoraic syllables. The last syllable [ha] is left unparsed due to the absolute ban on degenerate feet and the right edge consonant is regarded as extrametrical. According to the prominence projection grid in (b), the initial syllable CVG is treated as heavy and indicated with two asterisks, whilst the non-final CVC syllable is treated as light and indicated with one asterisk. Stress is straightforwardly assigned to the most prominent syllable in the word indicated by two asterisks. By the same token, the prominence analysis can account for the failure of ERR to assign stress to the rightmost visible foot (CVC) if it is preceded by either a CVV or a CVVG syllable in the word. Consider the following derivation for the words [ˈðˤa:r.rat.ham] 'she hurt them' and [ˈku:.rat.hin] 'their (fem.) ball' adopting the prominence projection grid to assign the correct stress assignment, as sketched in (5.28):

(5.28) SHH → (H)(H)L, HHH → (H)(H)L

a. Foot construction

```
   (x)      (x)
    –         –         ˘
  ðˤ a: r   r a t   h a ⟨m⟩
```

b. Projection of prominence grid, ERR

(x)

(x) (x)

– – ˘

ðˤ a: r r a t h a ⟨m⟩

* *

*

c. Foot construction

(x) (x)

– – ˘

k u: r a t h i ⟨n⟩

d. Projection of prominence grid, ERR

(x)

(x) (x)

– – ˘

k u: r a t h i ⟨n⟩

* *

*

The metrical presentation in (a) shows that two binary moraic trochee feet are created over two bimoraic syllables and the last light syllable is left over unfooted due to the ban on degenerate feet. In (b), I relied on the prominence projection grid to distinguish between bimoraic syllables in order to ensure ERR selects the stressed syllable correctly. It should be clear that the stress falls on the most prominent syllable based on the prominence projection grid. That is, ERR assigns stress to the most prominent syllable, which is indicated by two asterisks compared to the second syllable with one asterisk. In (c), two feet are constructed over two bimoraic syllables. The rightmost light syllable is left unfooted due to the ban on degenerate feet in the language. To avoid assigning stress incorrectly, the representation in (d) assigns stress according to the syllable prominence. Thus, ERR assigns stress to the rightmost non-final prominent syllable presented with two asterisks.

Finally, in the presence of more than one prominent syllable within the same word, stress is assigned to the rightmost CVG/CVV syllables. Consider the following derivation for the metrical structure HHL of the word [kar.ˈra:.sah] ‘booklet’ adopting the prominence projection grid to assign the correct stress assignment, as sketched in (5.29):

(5.29) HHH → (H)(H)L

a. Foot construction

```
    (x)    (x)
     –      –     ˘

  k a r   r a:   s a ⟨h⟩
```

b. Projection of prominence grid, ERR

```
(          x            )
   (x)     (x)
    –       –     ˘

 k a r   r a:   s a ⟨h⟩
    *       *
    *       *
            *
```

It should be noted from the representations in (5.29) that we have two equal prominent adjacent heavy syllables CVG and CVV. ERR chooses the rightmost non-final prominent syllable presented with two asterisks.

To conclude this section, I have provided a comprehensive description and analysis of foot construction to examine the general stress assignment rules found in NNA. It has been argued that the stress system is trochaic, and the foot size is maximally bimoraic for monosyllabic and disyllabic feet. Following Hayes' (1995) bracketed grid-approach, the metrical system in NNA constitutes the basic rules which are summarised in (5.30) as follows:

(5.30) The Rules of Metrical System in NNA

a.	Consonant Extrametricality	C → ⟨C⟩ __] word
b.	Foot Construction	Form moraic trochees from left to right. Degenerate feet are forbidden absolutely.
c.	Word Layer Construction	End Rule Right

Moreover, the analysis of foot construction required this study to invoke some additional principles to meet the general stress patterns in the language. These principles are weak local parsing, persistent footing, along with the rules presented in (5.30) (Hayes 1995). Taking these principles into account, a unified stress rule was obtained stating that the rightmost bimoraic or disyllabic visible trochee foot always receives stress in the word. However, this analysis fails to account for stress assignment in cases where two non-final heavy consecutive syllables occur within the same word, namely CVV/CVG/CVVG syllables and non-final CVC syllables. In these cases, the correct stress falls on the leftmost foot rather than the rightmost one in the word. Thus, ERR fails to assign stress to the rightmost visible foot. To achieve a plausible account for stress assignment in NNA, this study adopted the prominence projection grid to analyse the hierarchy of different weight degrees in heavy syllables (Davis 1988, Prince and Smolensky 1993, Hayes 1995, Watson 2002). It has been found that ERR assigns stress to the rightmost prominent syllable rather than to the heaviest syllable based on the distinction between the source of weight for each syllable proposed by Morén (1999).

After furnishing a comprehensive description and analysis of foot construction in NNA, we now turn to analyse the stress system in the dialect under the tenets of Optimality Theory, as will be shown in subsequent section.

5.5 Optimality-Theoretic Analysis

In this section, I will introduce an optimality-theoretic analysis of the presented stress patterns and foot construction in NNA, building on most key insights of Prince and Smolensky (1993/2004), McCarthy and Prince (1993), Hayes (1995), and Kager (1999). The analysis will be based on the observation that weak local parsing skips over light syllables unparsed whenever necessary throughout the course of foot construction in the language. On that account, NNA shows a fairly clear preference to separate feet with an unparsed light syllable between each foot yielding a ternary pattern employing only binary feet (Kager 1994, 2001, 2007, Hayes 1995, Gordon 2002, Elenbaas 1999, Elenbaas and Kager 1999, Alahmari 2018). That is, ternarity occurs by licensing, including interactions of the anti-lapse constraint *LAPSE (forbidden long strings of unstressed syllables) with two standard foot alignment constraints ALL-FT-LEFT and ALL-FT-RIGHT along with other relevant constraints (Elenbaas and Kager 1999: 274). In the current analysis, I argue that NNA has a binary stress assignment and the underparse of light syllables is proposed in order to comply with the rhythm constraint *CLASH. These generalisations show that a light syllable followed by a heavy syllable can possibly be footed as L(H), leaving the initial light syllable unfooted via the parameters of weak local parsing and the priority clause. Likewise, a heavy syllable followed by a light syllable can be footed as (H)L, where the final light syllable is left unparsed through the absolute ban on degenerate feet in the language. In this section, I will begin the analysis by taking into account the issue of directionality of foot parsing. After that, I will shed light on foot construction that controls the stress system under the effect of local ternary intervals, as well as other related phenomena in the understudied dialect.

Before accounting for directionality, we should consider the condition of stress assignment in NNA, in which every content word must contain one and only one stressed syllable. This merit is translated into an OT constraint known as CULMINTIVITY (CULM), which is defined in (5.31) below:

(5.31) CULMINTIVITY (CULM) (Hayes 1995)

Every prosodic word has one and only one primary stressed syllable.

This constraint penalises any output that does not assign one main stress or assign more than one main stress to the word. Thus, it is highly ranked and must be respected in the grammar of NNA. More importantly, the stress system is trochaic. As for headedness, two constraints should be invoked to differentiate between the two rhythmic types of feet: RHTYPE=TROCHAIC (T) or RHTYPE=IAMB (I). These constraints are defined below in (5.32):

(5.32) Head Feet Constraints (Prince and Somlensky 1993)

a. RHTYPE=T

Feet have initial prominence (left-headed).

b. RHTYPE=I

Feet have final prominence (right-headed).

It should be clear that the constraint of trochaic feet RHTYPE=T outranks the iambic feet constraint RHTYPE=I in order to obtain the correct optimal output with the optimal head foot location. The following tableau (5.33) illustrates how these constraints function to evaluate the word [ħaʃarah] ‘insect:

(5.33) /ħaʃarah/ → [(ˈħa.ʃa).rah] ‘insect’

/ħaʃarah/	CULM	RHTYPE=T	RHTYPE=I
a. ☞ (ˈħa.ʃa).rah			*
b. (ħa.ˈʃa).rah		*!	
c. (ħa.ˈʃa).(ˈrah)	*!	*	
d. (ħa.ʃa).(rah)	*!	*	*

It should be clear from the tableau above that a candidate assigns either no stress at all or more than one stress in the given content word fails to satisfy the high-ranked constraint CULM, as in (c) and (d). Candidate (b) is ruled out because it violates the high-ranked constraint RHTYPE=T as the head of the foot is final, but not initial. Consequently, candidate (a) wins the competition by virtue of respecting the undominated constraints CULM and RHTYPE=T.

Going back to directionality, the direction of foot parsing is governed by the interaction of the foot alignment constraints ALL-FT-LEFT and ALL-FT-RIGHT with other pertinent constraints that determine foot size and persistent parsing, i.e., FT-BIN and PARSE-SYL (McCarthy and Prince 1993, Kager 1999). Under OT, directionality of parsing in the course of foot configuration results from the relative ranking status of the constraints of foot alignment, foot binarity, and exhaustively parsing syllables. Consider the following constraints of directionality and foot alignment, as are defined in (5.34) below:

(5.34) Directionality and Foot Alignment Constraints (McCarthy and Prince 1993)

a. ALL-FT-RIGHT

Align (Ft, Right, PrWD, Right)   right-to-left

Assign one violation for every syllable that intervenes between the foot and the right edge of the prosodic word.

b. ALL-FT-LEFT

Align (Ft, Left, PrWD, Left)   left-to-right

Assign one violation for every syllable that intervenes between the foot and the left edge of the prosodic word.

A pair of foot alignment constraints are gradient constraints, which require the right/left edge of every foot to correspond with the right/left edge of a prosodic word. Hence, any foot in the prosodic word that is not aligned with a required word edge, i.e., left or right edge, will incur a violation based on the number of syllables between the foot and the word edge. In terms of directionality of foot construction in NNA, the left foot alignment constraint ALL-FT-LEFT is ranked above the right foot alignment ALL-FT-RIGHT due to the strong orientation of words with non-final stress. Thus, it is preferred that the direction of parsing is aligned to the left edge over the right edge of the prosodic word in NNA.

As mentioned earlier, foot size is restricted to be minimally binary at the mora level or at the syllable level, and all syllables are required to be persistently parsed. These cases are translated into two different constraints, as shown under (5.35):

(5.35) Foot Size and Persistent Footing Constraints

a. Foot Binarity (FT-BIN) (Prince and Smolensky 1993)

Feet are binary at some level of moraic or syllabic analysis.

b. PARSE-SYL (McCarthy and Prince 1993)

All syllables must be parsed into feet in a prosodic word.

The foot size constraint (a) denotes that the minimum weight of a foot is bimoraic and the maximum is disyllabic, i.e., disyllabic (LL) or monosyllabic (H), (S). Also, this constraint confirms that degenerate feet are banned in the language. In (b), the constraint PARSE-SYL supports the function of the classical metrical parameter Persistent Footing, which is in charge of exhaustive footing in certain cases (Hayes 1995). However, exhaustive foot parsing cannot be achieved in words containing an odd number of syllables due to the high-ranked constraint FT-BIN and the ban on degenerate feet, leaving an unparsed syllable at the edge.

We now consider the analysis of directionality of foot parsing. Consider the following tableau (5.36), which illustrates the direct interaction between foot alignment constraints to assess foot alignment for the word [ˈħa.ʃa.ra⟨h⟩] 'insect':

(5.36) /ħa.ʃa.rah/ → [(ˈħa.ʃa).ra⟨h⟩] 'insect'

/ħa.ʃa.rah/	ALL-FT-LEFT	ALL-FT-RIGHT
a. ☞ (ˈħa.ʃa).ra⟨h⟩		*
b. ħa.(ˈʃa.ra)⟨h⟩	*!	

The tableau (5.36) shows that directionality of foot parsing is constructed from left to right in which the left foot alignment constraint ALL-FT-LEFT must outrank the right foot alignment constraint ALL-FT-RIGHT. Therefore, candidate (a) is selected as the winning output yielding the correct stress pattern and foot parsing. Candidate (b) fails to satisfy the undominated constraint ALL-FT-LEFT by leaving the initial syllable unfooted and causing an incorrect stress pattern in NNA.

Let us now proceed to the notion of parsing syllables into feet. This notion is perceived by the constraint PARSE-SYL, which should be ranked lower in order to maintain the optimal output with degenerate feet. A legitimate foot is evaluated by the high-ranked constraint FT-BIN, where foot binarity is obligatory to ensure ruling out any degenerate foot that occurs during parsing. Hence, the nonexhaustivity condition is employed, which in turn violates the parsing syllable constraint PARSE-SYL. The following tableau (5.37) exhibits close interaction between the two constraints FT-BIN >> PARSE-SYL:

(5.37) /maktab/ → [(ˈmak).ta⟨h⟩] 'office'

/maktab/	FT-BIN	PARSE-SYL
a. ☞ (ˈmak).ta⟨h⟩		*
b. (ˈmak).(ta)⟨h⟩]	*!	

The tableau above demonstrates that candidate (a) is the winner because it satisfies the undominated constraint FT-BIN and allows only for minimal violation of the dominated constraint PARSE-SYL by skipping over the final light syllable unfooted (the last consonant is extrametrical). Candidate (b) is ruled out by the undominated foot binarity constraint because it parses the light syllable into a unary foot creating a degenerate foot. Overall, this ranking argument captures the idea that the persistent footing does not impose serious restrictions on the optimal output to parse the right edge syllable because the constraint PARSE-SYL is dominated by FT-BIN, i.e., FT-BIN >> PARSE-SYL.

In what follows, I will introduce a ranking argument that manifests an important interaction between the foot alignment constraint ALL-FT-LEFT and the parsing syllable constraint PARSE-SYL. Kager (1994) asserted that ranking the foot alignment constraints higher than the constraint PARSE-SYL would restrict candidates to surface with only one foot per word. Thus, the constraint PARSE-SYL should outrank foot alignment constraints in order to allow multiple foot parsing. Now, we should examine the proposed constraint ranking with stress assignment in the language. Consider the following tableau (5.38) to evaluate a word that consists of four syllables:

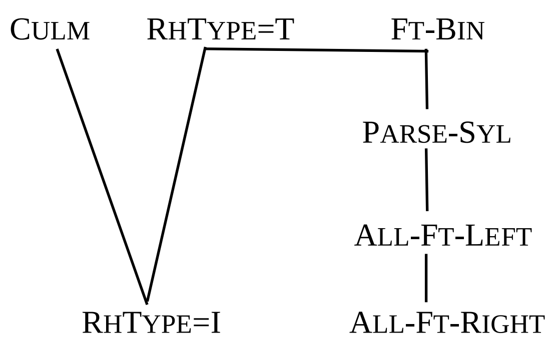
(5.38) /ʔintχibt/ → [(ʔin).(ˈtχib)⟨h⟩] ‘I was elected’

/ʔintχibt/	PARSE-SYL	ALL-FT-LEFT
a. ☞ (ʔin).(ˈtχib)⟨h⟩		*
b. (ˈʔin).tχib⟨h⟩	*!	

This tableau displays that candidate (a) is selected as the winner output because it satisfies the high-ranked constraint PARSE-SYL by parsing all syllables at the expense of violating the foot alignment constraint by parsing the foot of the right edge of the word. In (b), skipping over one bimoraic syllable causes fatal violation of the high-ranked constraint PARSE-SYL, and thus it is eliminated.

The general ranking argument for the previous constraints in NNA are introduced in the following Hasse diagram, as in (5.39) below:

(5.39) Constraint ranking Summary



The ranking argument summary in (5.39) assures that every content word contains one and only one primary stressed syllable and illustrates the stress system is trochaic but not iambic in NNA. In addition, the right Hasse diagram displays the ranking argument for the direction of foot parsing and the restriction of the foot size along with parsing syllables in the language.

It should be noted that the stress patterns in NNA prefer word-initial stress more than word-final stress. Also, in NNA, words always begin with a foot, unless the initial syllable cannot support foot requirements, as in [ðˤa.(ˈrabt)] ‘I hit’ and [ki.(tab).tu⟨h⟩] ‘I wrote it’, where the initial light syllables are left over unfooted due to weak local parsing. To account for the fluctuating location of stress or foot construction in NNA, we should invoke another pair of word alignment constraints that govern edge stress assignment: ALIGN-PRWD-LEFT and ALIGN-PRWD-RIGHT (McCarthy and Prince 1993). The word alignment constraints are formalised in (5.40) below:

(5.40) Word Alignment Constraints (McCarthy and Prince 1993)

a. ALIGN-PRWD-LEFT
Align (PrWd, Left, Ft, Left)

Every PrWd begins with a foot.

b. ALIGN-PRWD-RIGHT
Align (PrWd, Right, Ft, Right)

Every PrWd ends in a foot.

These constraints are violated when no primary stress is placed on a foot at a particular edge of the word. The constraint ALIGN-PRWD-LEFT requires the left edge of the prosodic word to be consistent with the left edge of a foot. However, the constraint ALIGN-PRWD-RIGHT requires the right edge of the prosodic word to be consistent with the right edge of a foot. A noteworthy of mention here is that word alignment constraints are different from foot alignment constraints in which the former constraints deal with word edges regarding feet (word-to-foot alignment) and the latter constraints deal with feet regarding word edges (foot-to-word alignment) (cf. Kager 1999). More to the point, the word alignment constraint ALIGN-PRWD-LEFT requires the prosodic word to begin with a foot, whilst the foot alignment constraint ALL-FT-LEFT enforces feet to be constructed at the left edge of the word. In OT perspectives, the word alignment constraints outrank the foot alignment constraints because the stress system in NNA prefers left-edge alignment over left-edge foot construction, i.e., ALIGN-PRWD-LEFT >> ALL-FT-LEFT. This ranking argument can be achieved with a word that assigns stress to the rightmost foot. Consider the following tableau, as shown in (5.41) below:

(5.41) /wiʃ.nu.ħi/ → [(ˈwiʃ).(nu.ħi)] ‘what’s my problem!’

/wiʃnuħi/	ALIGN-PRWD-LEFT	ALL-FT-LEFT
a. ☞ (ˈwiʃ).(nu.ħi)		*
b. wiʃ.(ˈnu.ħi)	*!	*

Candidate (a) wins the competition because it respects the undominated constraint ALIGN-PRWD-LEFT, as the prosodic word begins with a foot, but it minimally violates the dominated constraint ALL-FT-LEFT by constructing a foot at the right edge of the prosodic word. Candidate (b) is eliminated because it fatally violates the word alignment constraint since the initial bimoraic syllable is left over unfooted in the prosodic word.

The word alignment constraint ALIGN-PRWD-LEFT should be respected in the grammar of NNA, unless a potential degenerate foot occurs word-initially during parsing in the language. Hence, this constraint should be dominated by the most high-ranked constraint FT-BIN in order to guarantee the prohibition of degenerate feet is met. Recall that this assumption was reported by Hayes (1995) under the influence of the Priority Clause principle and Weak Local Parsing. Consider the following tableau (5.42) to evaluate a word that begins with a light syllable where it is left unfooted followed by a bimoraic syllable:

(5.42) /ðiba:n/ → [ði.(ˈba:n)] ‘opportunist’

/ðiba:n/	FT-BIN	ALIGN-PRWD-LEFT
a. ☞ ði.(ˈba:n)		*
b. (ði).(ˈba:n)	*!	

The tableau above exhibits that candidate (a) is selected as the winner by virtue of respecting the top ranked constraint FT-BIN and leaving the initial light syllable unfooted. Candidate (b) is clearly ruled out because it fatally violates the foot binarity constraint since the degenerate monomoraic foot is parsed.

We have observed that NNA displays weak local parsing and the priority clause condition in which a light syllable is skipped over to avoid degenerate feet. Languages are different from each other in terms of foot structural configuration. That is, some languages are based on binary alternation, which sometimes causes clashes or lapses. Other languages employ a ternary alternation where stresses are separated by weak syllables, rendering stresses to lodge on every third syllable. Assuming a candidate as (ˈH)(ˈLL) contains a pair of clashing feet, whereas a candidate as (ˈLL)(ˈLL) does not, to avoid the dilemma of stress clashes, a ternary alternation is implemented to conserve a minimal distance between feet. In OT terminology, to eliminate a disfavoured output like the metrical structure (ˈH)(ˈLL) in the language, we should resort to the rhythm constraint *CLASH. This constraint is defined in (5.43) below:

(5.43) *CLASH (Kager 1999)

No stressed syllables are adjacent.

This constraint discriminates against any output with adjacent stressed syllables or head feet. Thus, satisfying the anti-clash constraint *CLASH would result in unsuitable foot alignment. Hence, the anti-clash constraint should dominate both the foot alignment constraint ALL-FT-LEFT and the parsing syllable constraint PARSE-SYL because exhaustive feet parsing is disfavoured in the language in such cases. To demonstrate this ranking argument, consider the following tableau (5.44), which manifests the role of the anti-clash constraint and other relevant constraints:

(5.44) /ʕallimitah/ → [(ʕal).li.(ˈmi.ta)⟨h⟩] ‘she told her’

/ʕallimitah/	*CLASH	PARSE-SYL	ALL-FT-LEFT
a. ☞(ʕal).li.(ˈmi.ta)⟨h⟩		*	**
b. ʕal.(li.ˈmi).ta⟨h⟩		**!	*
c. (ʕal).li.ˈmi.ta⟨h⟩		***!	
d. (ʕal).(ˈli.mi).ta⟨h⟩	*!	*	*

Tableau (5.44) displays the crucial ranking argument between the constraint *CLASH, PARSE-SYL, and ALL-FT-LEFT. Candidate (a) is the optimal output since it respects the top ranked constraint *CLASH by skipping the light syllable unfooted between the feet to avoid a stress clash. Also, it allows only minimal violation of the constraint PARSE-SYL. Candidates (b) and (c) are ruled out due to violation of the parsing syllable constraint, where a bimoraic syllable or more than two light syllables are left over unparsed. Finally, candidate (d) fails to satisfy the top ranked constraint *CLASH by parsing two adjacent head feet.

A similar ranking argument is true for a form containing the syllabic structure [HLLS]. Consider the following tableau (5.45) to evaluate the word [mis.ti.fi.ˈdi:n] 'beneficiaries (mas.)':

(5.45) /mistifidi:n/ → [(mis).ti.fi.(ˈdi:n)] 'beneficiaries (mas.)'

/mistifidi:n/	*CLASH	PARSE-SYL	ALL-FT-LEFT
a. ☞(mis).ti.fi.(ˈdi:)⟨n⟩		**	***
b. (mis).(ˈti.fi).(di:)⟨n⟩	*!		**
c. mis.ti.fi.(ˈdi:)⟨n⟩		**!*	***

As can be seen in tableau (5.45), candidate (a) is selected as the winner form by virtue of respecting the top ranked constraint *CLASH. Candidate (b) is ruled out, even though it attains an exhaustive parsing of the word causing a stress clash. Candidate (c) loses the competition because it fatally violates the constraints PARSE-SYL and ALL-FT-LEFT, even though it satisfies the top ranked constraint *CLASH.

So far we have introduced the constraints that account for the stress patterns and foot construction in NNA, concentrating on some aspects like foot directionality, word alignment, parsing syllables, and foot binarity. Let us now examine the validity of the previous ranking arguments with different examples, FT-BIN, RHTYPE=T >> ALIGN-PRWD-LEFT, *CLASH >> PARSE-SYL >> ALL-FT-LEFT. Consider the following tableau (5.46) to illustrate how the three-syllable word [ˈbe:.ta.na] 'our house' of the metrical form [HLL] is analysed under the ranking argument developed so far:

(5.46) /be:tana/ → [(ˈbe:).ta.na] ‘our house’

/be:tana/	FT-BIN	RHTYPE=T	ALIGN-PRWD-LEFT	*CLASH	PARSE-SYL	ALL-FT-LEFT
a. ☞ (ˈbe:).ta.na					**	
b. (ˈbe:).ta.(na)	*!				*	**
c. (be:).(ta.ˈna)		*!				*
d. be:.(ˈta.na)			*!		*	**
e. (ˈbe:).(ta.na)				*!		*

It should be noted that the proposed ranking argument accomplished the purpose of the test. Candidate (a) is the optimal output since it respects all the undominated constraint and allows only for minimal violation of the dominated constraint PARSE-SYL by leaving two successive light syllables unparsed. Allowing degenerate feet leads to serious violation of the top ranked constraint FT-BIN as seen in (b). Satisfying the anti-clash constraint by moving stress to the non-adjacent syllable causes the serious violation of the top high-ranked constraint RHTYPE=T, as in the output (c). Candidate (d) is ruled out by incurring violation of the high-ranked constraint ALIGN-PRWD-LEFT because it does not construct a foot in the beginning of the prosodic word. In candidate (e), the idea of exhaustive parsing causes violation of the anti-clash constraint *CLASH, thus it is eliminated. It is worthwhile to note that without adopting the word alignment constraint ALIGN-PRWD-LEFT, the optimal form [(ˈbe:).ta.na] is predicted to lose, allowing candidate (d) [be:.(ta.ˈna)] to be wrongly selected as optimal output. If this is the case, candidate (a) violates the parsing syllable constraint PARSE-SYL only once, while candidate (d) violates it twice. A notable generalisation here is that words always begin with a foot, unless the initial light syllable cannot support a foot, as in [ði.(ˈba:n)] , not * [(ði).(ˈba:n)].

We have constructed a valid ranking argument in a summary tableau that accounts for the stress assignment and foot construction in NNA. However, this previous ranking argument needs to be checked with other forms to ensure consistency. A form that consists of four syllables will be examined under the same ranking. Consider the following tableau (5.47) to test the quadrisyllabic word [dar.ri.ˈsi.tuh] ‘she taught him’:

(5.47) /dar:isituh/ → [(dar).ri.(ˈsi.tu)⟨h⟩] 'she taught him'

/dar:isituh/	FT-BIN	RHTYPE=T	ALIGN-PRWD-LEFT	*CLASH	PARSE-SYL	ALL-FT-LEFT
a. ☞(dar).ri.(ˈsi.tu)⟨h⟩					*	**
b. (ˈdar).ri.si.(tu)⟨h⟩	*!				**	***
c. (dar).(ri.ˈsi).tu⟨h⟩		*!				*
d. dar.ri.(ˈsi.tu)⟨h⟩			*!		*	***
e. (dar).(ˈri.si).tu⟨h⟩				*!	*	*

As can be observed from tableau (5.47), candidate (a) emerges as the winner form by satisfying the four high-ranked constraints FT-BIN, RHTYPE=T, ALIGN-PRWD-LEFT, and *CLASH. Candidate (b) is eliminated because it incurs one fatal violation of the foot binarity constraint FT-BIN by creating a degenerate foot. Candidate (c) loses because it violates the foot type constraint RHTYPE=T by creating an iambic foot to avoid a stress clash. Candidate (d) is ruled out by the alignment foot constraint ALIGN-PRWD-LEFT. Finally, candidate (e) incurs one violation of the high-ranked constraint by constructing two adjacent head feet and double violations of the dominated constraints PARSE-SYL and ALL-FT-LEFT.

Now, we will examine a form containing HLL under the same ranking argument. Consider the following tableau in order to evaluate the word [(ˈʔam).mi.hi⟨n⟩] 'their (fem.) uncle', as depicted in (5.48) below:

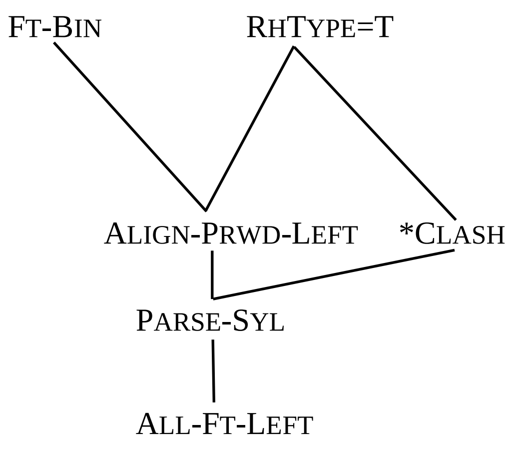
(5.48) /ʔam.mi.hin/ → [(ˈʔam).mi.hi⟨n⟩] ‘their (fem.) uncle’

[ˈʔam.mi.hin]	FT-BIN	RHTYPE=T	ALIGN-PRWD-LEFT	*CLASH	PARSE-SYL	ALL-FT-LEFT
a. ☞ (ˈʔam).mi.hi⟨n⟩					**	
b. (ˈʔam).mi.(hi)⟨n⟩	*!				*	**
c. (ʔam).(mi.ˈhi)⟨n⟩		*!				*
d. ʔam.(mi.ˈhi)⟨n⟩			*!		*	**
b. (ʔam).(ˈmi.hi)⟨n⟩				*!		*

As can be seen from the above tableau, candidate (a) is selected as the optimal form by virtue of respecting all the undominated constraints and allowing only for minimal violation of the syllable parsing constraint PARSE-SYL. Candidate (b), as a strong rival, is immediately ruled out because it allows a degenerate foot to be constructed, violating the top-ranked foot binarity constraint FT-BIN. Candidate (c) shows an iambic stress, and it thus violates the foot type constraint RHTYPE=T. Candidate (d) violates of the word alignment constraint by not constructing a foot at the beginning of the prosodic words.

The overall constraint ranking proposed is sketched in the following diagram, as shown in (5.49) below:

(5.49) Constraint ranking summary



After establishing the relative constraints that account for foot construction in the language, I will endeavour to show how stress is assigned in NNA. As mentioned in the previous section, stress is placed by the effect of the End Rule Right (ERR) parameter, selecting the rightmost non-final visible foot in the parse to receive the main stress in a given word. In OT terms, an End Rule parameter is interpreted as EDGEMOST constraints (McCarthy and Prince 1993, Kager 1999). These constraints require the stressed syllable or the strongest foot to be aligned at a specific edge of a prosodic word. In the current analysis, EDGEMOST constraints are gradient in which any foot or syllable intervening between the head foot and the edge of the prosodic word assigns one violation. Overall, to account for stress assignment after foot construction is made, we should adopt the family of metrical alignment constraints concerning head foot alignment. These constraints are expressed in (5.50) below:

(5.50) Head Foot Alignment Constraints (McCarthy and Prince 1993/2004, Kager 1999)

a. LEFTMOST

Align (Hd-Ft, Left, PrWd, Left)

The head foot is leftmost in PrWd.

b. RIGHTMOST

Align (Hd-Ft, Right, PrWd, Right)

The head foot is rightmost in PrWd.

We can infer from the constraints in (5.50) that the relevant constraint to our analysis is RIGHTMOST, which represents the parameter of ERR due to the higher priority to stress the rightmost foot in the language. This constraint requires the head foot to be the rightmost foot, regardless of whether or not it is in contact with the right word edge. That is, the rightmost head foot should not be final in the language. This statement would not go against constructing a foot in final superheavy syllables or a CVC syllable of the prosodic word. To illustrate that, it has already been reported that the final consonant of superheavy syllables (CVVG/CVVC/CVCC) is deemed extrasyllabic, whereas the final consonant of a CVC is deemed extrametrical. In both accounts, a final segment forms a degenerate syllable (McCarthy 1979b, Hayes 1995, Crowhurst 1996). In OT, this issue can be explained by the constraint NONFINALITY, which prohibits head feet to be constructed word-finally that align at the right edge of the prosodic word. Under this view, it has been observed that extrasyllabicity and extrametricality block a head foot from being at the right periphery of a prosodic word. The constraint NONFINALITY is formulated in (5.51) below:

(5.51) NONFINALITY (NON-FIN) (Prince and Smolensky 1993/2004)

The head foot of the PrWd must not be final.

This constraint discourages the head foot that resides at the peripheral right edge of the prosodic word. NON-FIN is regarded as the OT equivalent of extrametricality (Hung 1994, Prince and Smolensky 1993, Kager 1999, and Hyde 2002), which prevents the head foot from being at the right edge of the prosodic word. Thus, the constraint NON-FIN is respected in the presence of extrasyllabicitiy in CVVC, CVVG, and CVCC word-finally. However, the constraint NON-FIN is in direct conflict with the head foot alignment constraint RIGHTMOST, which enforces the head foot to be aligned to the right edge of the prosodic word. As a result, the constraint RIGHTMOST is dominated by the constraint NON-FIN to ensure that the head foot must not be final in the prosodic word. To see how these constraints are interacted in OT, consider the following tableau that demonstrates the ban on final head foot under the ranking argument NON-FIN >> RIGHTMOST, as shown in (5.52):

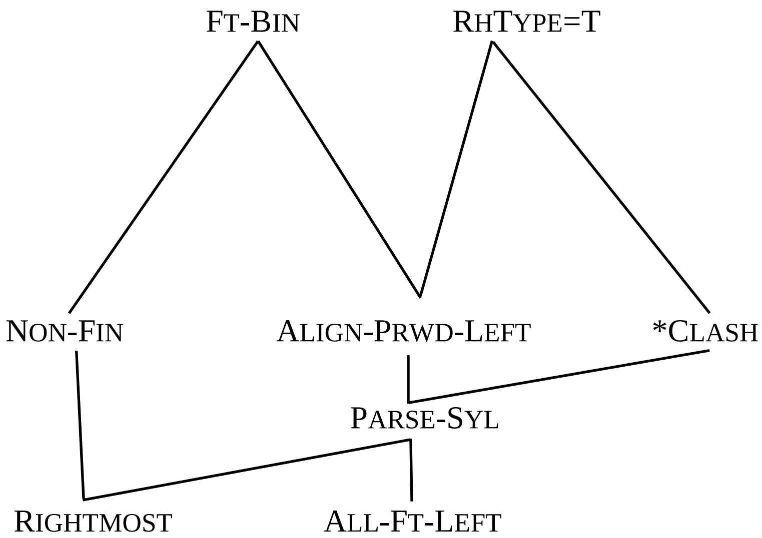
(5.52) /ʔistidart/ → [(ʔis).ti.(ˈdar)⟨t⟩] ‘I go around’

/ʔistidart/	NON-FIN	RIGHTMOST
a. ☞ (ʔis).ti.(ˈdar)⟨t⟩		*
b. (ʔis).ti.(ˈdart)	*!	

In tableau (5.52), candidate (a) is selected as the winner by virtue of respecting the undominated constraint NON-FIN because the extrasyllabic consonant ⟨t⟩ blocks a foot from being final, but allowing to minimally violate the dominated constraint RIGHTMOST. Candidate (b) is ruled out because it violates the constraint NON-FIN since the head foot are constructed word-finally. All in all, we have noted that the constraint NON-FIN is very effective with all words that show a peripheral foot in NNA.

So far we have established the general ranking argument to account for the syllable parsing and stress location of the prosodic word in NNA. The overall constraint ranking developed is sketched in the following diagram, as shown in (5.53) below:

(5.53) Constraint ranking summary



We now turn to account for the stress of heavy syllables in NNA. As mentioned in the previous chapters, non-final CVC syllables are considered heavy due to the enforcement of the Weight-By-Position (WBP) principle, which assigns moras only to internal coda consonants (Hayes 1989). Thus, we should differentiate between final and non-final CVC syllables in terms of syllable weight. In OT model, recall that the constraints WBP and MAX-μ require a mora in the input to contain a correspondent in the output. These constraints interact with other conflicted constraints *FINAL-Cμ and SYLLFIN-L (Kager 1999, Bamakhramah 2009) (recall the definitions of these constraints in Chapter Three). The constraint *FINAL-Cμ militates against assigning mora to a coda consonant in a word-final syllable, whereas the constraint SYLLFIN-L militates against a non-moraic coda consonant in a word-final syllable. To see how WBP affects the stress placement in NNA, consider the following tableau which evaluates a word with a non-final CVC syllable, as shown in (5.54) below:

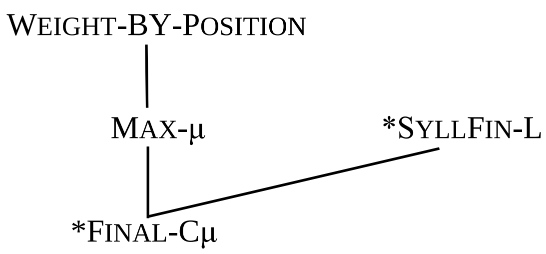
(5.54) [ˈʔiʃ.nuħ]→ [(ˈʔiʃ).nuħ] ‘why?’

μμ μ /ʔiʃ.nuħ/	WBP	MAX-μ	*FINAL-Cμ	SYLLFIN-L
μμ μ a. ☞ (ˈʔiʃ).nu⟨h⟩				*
μ μμ b. (ʔiʃ).(ˈnuħ)	*!	*	*	

As can be observed from tableau (5.54), candidate (a) is selected as the winner output because it obeys the high-ranked constraints WBP and MAX-μ, and only incurs one violation of the dominated constraint SYLLFIN-L, which disallows light syllables in a syllable-final position. Candidate (b) is ruled out since it fails to satisfy the undominated constraint WBP by not assigning a mora to the coda of a word-internal position. Also, it violates the high-ranked constraint MAX-μ along with *FINAL-Cμ by adding a mora to the coda in a word-final position that is assumed to be extrametrical, achieving the requirement of the constraint *FINAL-Cμ. All in all, the previous tableau illustrates the idea of creating a bimoraic foot over an internal CVC syllable and how stress is assigned to the rightmost non-final foot by the influence of NONFINALITY and RIGHTMOST.

It can be noted from the general stress patterns presented earlier that stress is assigned to the rightmost foot. Nevertheless, in cases where the geminate CVG and long vowels CVV are presented, these heavy syllables always attract stress over other heavy syllables like non-final CVC syllables, even though they are not positioned and footed in the rightmost edge of the prosodic word. As already stated, stress in NNA is typically sensitive to syllable weight. That is to say, we should clarify the prosodic difference between non-final CVC syllables and non-final CVG/CVV syllables and justify why they are unequally treated. The prosodic difference is ascribed to the syllabic weight source either distinctive intrinsic prominence or coerced extrinsic prominence (Morén 1999, 2003). The former weight type represents non-final CVG/CVV syllables because they are inherently bimoraic, as appeared on the surface since geminates and vowels are always moraic as opposed to singleton consonants. The latter weight type represents non-final CVC syllables because they are underlyingly monomoric since coda consonants are forced to be moraic only by the enforcement of WBP. Consequently, a CVC syllable is treated as heavy in a non-final word position, whilst it is treated as light in a final word position. The general constraint ranking proposed is given in the following diagram, as shown in (5.55) below:

(5.55) Constraint ranking summary



What emerges from the former presentation in this chapter is that there is a strong tendency to stress bimoraic CVC syllables when other bimoraic CVG/CVV syllables are absent in the word. This tendency supports the argument that coda consonants are always non-moraic except when they appear word-internally and attract stress, rendering a non-final CVC syllable heavy. Therefore, the coda consonants of non-final syllables are compelled to become moraic by virtue of the high-ranked constraint WEIGHT-TO-STRESS PRINCIPLE (WSP), which requires any heavy bimoraic syllable to be stressed (Kager 2007). It should be clear at this point that CVG/CVV syllables adhere to the constraint WSP because these syllables are underlyingly bimoraic. As a result, it is possible to account for the double role of CVC syllables in the presence or the absent of CVG/CVV syllables in a given word. Accordingly, stress lodges on the heavy CVG/CVV syllables due to their correlation with the peak prominence, whereas stress lodges on the CVC syllables in a non-final word position due to syllable weight and rhythm constraints interactions. Under this assumption, CVG/CVV syllables are considered to be more prominent compared to non-final CVC syllables. In OT, the prominence-driven systems can be translated into the prominence constraint PEAK-PROMINENCE, in which the main stress falls on the most prominent heavy syllables in the grid (Prince and Smolensky 1993/2004, Walker 1997, Kager 2007). The prominence constraint is defined in (5.56) below:

(5.56) PEAK-PROMINENCE (Pk-PROM) (Prince and Smolensky 2004, Kager 2007)

Peak(x) is more harmonic than Peak(y) if |x| > |y|.

Basically, this constraint harmonizes the degree of a prominence peak in the grid column with the weight of a syllable. To clarify, ‘the element x is a better peak than y if the intrinsic prominence of x is greater than of that y', which represents the status, if stressed, then heavy (Prince and Smolensky 2004: 46). That is, this constraint ensures that the highest peak in the grid proposed by (Hayes 1995) should fall on the heaviest syllable, which in turn receives the main stress in a given word. Therefore, this constraint assigns violation if there is a stressed CVC or CV syllable in the presence of a CVVG, CVG, or CVV syllable elsewhere in the word. The constraint Pk-PROM recognises various degrees of syllable weight based on the prominence projection grid suggested by (Hayes 995). He presented a scale to show the degree of heaviness as follows:

(5.57) Heaviness Scale

|CVVG, CVG, CVV| > |CVC, CV|

This scale shows that CVVG/CVG/CVV syllables are more prominent than CVC and CV syllables. Hence, assigning stress to either CV/CVC syllables would violate the peak-prominence constraint in the presence of CVG/CVV syllables. This scale motivates the idea that the prominence-driven stress system hinges on an intrinsic prominence of the syllable rather than on foot structure (Prince and Smolensky 2004). Thus, the constraint Pk-PROM assigns one violation when each time stress fails to lodge on the strongest syllable in the word.

The other relevant constraint is the head foot alignment constraint RIGHTMOST, which determines the preferable position of the prominence-peak in the word. RIGHTMOST is subject to gradient violation, specified by the distance of the designated syllable from the word edge. The constraint RIGHTMOST should be ranked below Pk-PROM, yielding the constraint ranking Pk-PROM >> RIGHTMOST. To understand how these constraints play out, consider the following tableaux to show how stress is assigned to the rightmost non-final prominence-peak rather than to the rightmost non-final foot in the word, as portrayed in (5.58), (5.59), and (5.60), respectively:

(5.58) /ʔallamna/ → [ˈʔal.lam.na][43] 'he told us'

/ʔallamhna/	Pk-PROM	RIGHTMOST
a. ☞ ˈʔal.lam.na		**
b. ʔal.ˈlam.na	*!	*
c. ʔal.lam.ˈna	*!	

(5.59) /ðˤa:rratna/ → [ˈðˤa:r.rat.na] 'she hurt us'

/ðˤa:rratna/	Pk-PROM	RIGHTMOST
a. ☞ ˈðˤa:r.rat.na		**
b. ðˤa:r.ˈrat.na	*!	*
c. ðˤa:r.rat.ˈna	*!	

(5.60) /ku:ratna/ → [ˈku:.rat.na] 'our (mas.) ball'

/ku:ratna/	Pk-PROM	RIGHTMOST
a. ☞ ˈku:.rat.na		**
b. ku:.ˈrat.na	*!	*
c. ku:.rat.ˈna	*!	

All tableaux above show that CVVG/CVG/CVV syllables attract stress because they are more prominent than non-final CVC syllables. Thus, in all tableaux, candidate (a) is selected as the winner by virtue of respecting the undominated constraint Pk-PROM since stress lodges on the most prominent heavy syllables in the word, regardless of minimal violation of the head

[43] Remember that the /l/ in the initial syllable represents the first leg of the geminate (G), and the /m/ in the second syllable represents the coda.

alignment constraint RIGHTMOST. Candidate (b) and (c) are ruled out by the high-ranked constraint Pk-PROM because they ignore the most prominent CVVG/CVG/CVV syllables and assign stress incorrectly to non-final CVC syllables and final CV syllables. Ultimately, the overall ranking argument for the prominence-based system stressing is given below in (5.61):

(5.61) Constraint ranking summary

Pk-PROM
|
RIGHTMOST

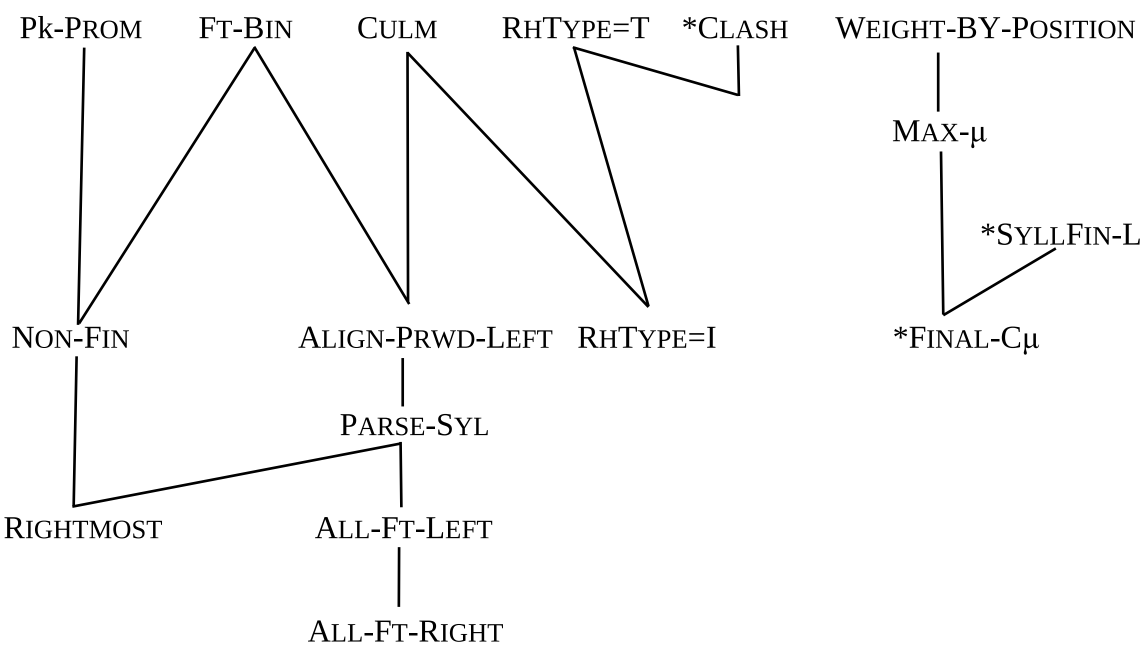
After establishing the ranking argument for stressing the most prominent syllable in the word, we should note that the constraint Pk-PROM is active in NNA and applied only to stress heavy CVG/CVV syllables in a given word. That is, in the absence of CVG/CVV syllables, stress assignment is not ascribed to prominence-driven stress systems, but rather to foot-driven stress systems. Under prominence-driven stress systems, the head foot alignment constraint RIGHTMOST affects the location of the main stress, in which the rightmost prominent syllable always receives stress. Overall, it seems that the prominence-driven stress account is a plausible proposal to account for stress assignment under the effect of geminates and long vowels. What seems to be extraordinary in such an analysis, we assume two different accounts to analyse one stress system, prominence-based constraint and foot-based constraint. This promptly raises a question about the possibility of reconciling the two analyses to resolve the effect of geminates and long vowels on stress assignment in NNA. In fact, the answer to this question is beyond the scope of this chapter and the thesis.

To wind up this section, I have developed an optimality-theoretic analysis to account for stress assignment and foot construction in the language. The stress pattern of NNA shows ternary alternations and a remarkable effect of geminates and long vowels on stress placement. The high-ranked constraints FT-BIN, CULM, and RHTYPE=T ensure that every prosodic word must receive one and only one primary stress, and the foot size is binary and trochaic. It should be noted that NNA implements various parameters in order to build a neat analysis of stress pattern and foot construction, such as weak local parsing, persistent footing, and the priority clause. The direction of parsing is determined by the high-ranked foot alignment constraint ALL-FT-LEFT, which ensures the foot parsing is constructed from left to right. The constraint PARSE-

SYL motivates the parameter of persistent footing. However, it is violated by the ban on degenerate feet in the dialect, weak local parsing, and the priority clause. Stress is assigned to the rightmost non-final visible foot satisfying the constraint RIGHTMOST. However, this constraint is in conflict with the constraint NON-FIN, which enforces the head foot to be assigned to the non-final rightmost visible foot. Therefore, the constraint RIGHTMOST is dominated by the constraint NON-FIN.

The preferred pattern in NNA is to split the adjacent head feet during parsing in order to avoid stress clash environments. This analysis can be realised by adopting the parameter of weak local parsing and by skipping over certain light syllables unfooted to satisfy the high-ranked constraint *CLASH, which bans stress clash. It has been shown that the location of stress can be affected by geminates and long vowels in the presence of non-final CVC syllables. This situation is interpreted by the notion of prominence-based stress system rather than foot-based stress system, where the most prominent syllable attracts stress based on the heaviness scale presented in (5.61). In OT terminology, this case is translated into the undominated constraint Pk-PROM, which should be respected in the grammar of NNA. Overall, the prominence-based stress account is the only way to account for the effect of geminates and long vowels CVG/CVV in the presence of non-final CVC syllables. Otherwise, stress is foot-driven system. Consider the final constraint ranking, as sketched in (5.62) below:

(5.62) Final constraint ranking for stress assignment and foot construction



5.6 Summary

This chapter explored and analysed the stress system in NNA, with the central focus on stress assignment and foot construction. It was shown that NNA is a quantity-sensitive dialect in which stress is typically based on syllable weight and position. We have also seen that NNA is a trochaic right-oriented system where stress is placed on the head of the rightmost foot in a word. With respect to foot construction, it has been argued that the foot size is minimally bimoraic, yielding a single heavy syllable, or maximally disyllabic, yielding two light syllables. Under Metrical Stress Theory (Hayes 1995), I employed certain parameters and principles to present a formal analysis under the tenets of Optimality Theory. More specifically, the stress pattern and foot construction in NNA are based on the ternary style of alternation, which is derived from the universal asymmetric foot configuration under pressure of the weak local parsing mode (Hayes 1995). Ternary systems maintain feet apart minimally by skipping one light syllable after a binary foot that has been established for the sake of preventing a potential stress clash in a word-internal position.

In OT analysis, a stress clash can be seen as a result of constraint interaction, between the constraint PARSE-SYL on one side and *CLASH and FT-BIN on the other, where the constraint PARSE-SYL is violated in order to satisfy either FT-BIN or *CLASH. On the other hand, if there is no stress clash environment, exhaustive parsing is satisfied, which is represented by the constraint PARSE-SYL and the parameter of persistent footing. A family of alignment constraints are implemented to account for stress assignment and foot construction in the language. These constraints are directionality and foot alignment, word alignment, and head foot alignment. The word alignment constraint ALIGN-PRWD-LEFT is adopted to account for word-initial stress by ensuring every prosodic word to begin with a foot. This constraint dominates the other word alignment constraint ALIGN-PRWD-RIGHT due to the high tendency of words with non-final stress. Directionality of footing is interpreted by the interaction between the foot alignment constraints ALL-FT-LEFT and ALL-FT-RIGHT, where the constraint ALL-FT-LEFT is ranked higher than ALL-FT-RIGHT since parsing starts from left to right. Thus, the foot alignment constraint ALL-FT-LEFT is unsatisfied when each foot is not aligned to the left edge of the word. The former high-ranked constraint leads to the correct selection of the head foot alignment, where the constraint RIGHTMOST selects the rightmost foot over the leftmost foot to receive the main stress in the language. However, the foot alignment constraint RIGHTMOST conflicts with the constraint NON-FIN, which penalises any head foot aligning to the right edge of the prosodic word. That is, the constraint NON-FIN enforces stress assignment to the rightmost non-final foot, yielding the constraint ranking NON-FIN >> RIGHTMOST.

What was unusual throughout the analysis was the asymmetric behaviour of heavy syllables in attracting stress, even though they were positioned and footed in the non-final rightmost of a prosodic word. It has been argued that a non-final CVC syllable attracts stress when it is the only heavy syllable presented in the word. Bear in mind that final CVC syllables are treated as light because the final consonant is extrametrical and the parameter of WBP is applied only to non-final CVC syllables. In the presence of geminates or long vowels CVG/CVV and non-final CVC syllables within the same word, stress always lodges on CVG/CVV syllables, regardless of their position in the word. This special situation is ascribed to the idea that CVG/CVV syllables are underlyingly bimoraic (heavy), as opposed to a non-final CVC syllable, which assigns weight only by the enforcement of WBP. Under this analysis, non-final CVC syllables are viewed as weight-based constraint interactions, whilst CVG/CVV syllables are viewed as prominence-based constraint represented by Pk-PROM. Under this analysis, we argue that NNA has a binary stress system with the effect of ternary alternations and syllable prominence resulting from constraint interactions and scalar quantity-sensitivity. What seems to be a drawback in our analysis, however, is that there are two different accounts, namely a prominence-driven stress system and a foot-driven stress system to analyse one stress system. Unifying these two accounts into a single account lies outside the scope of the current study.

Chapter 6. Concluding Remarks and Future Research

6.1 Introduction

The essential aim of the current study was to describe and analyse some aspects of the phonology of Northern Najdi Arabic (NNA) that have not received considerable attention in the literature within Arabic dialects in light of Optimality Theory (OT). Throughout the thesis, three main phonological aspects have been tackled in the present analysis of NNA. The first aspect pertained to syllable structure and syllabification patterns with special emphasis on the status of final and non-final superheavy syllables to avoid trimoraicity. The second aspect pertained to the formation of consonant clusters and the licit and illicit consonant clusters in the dialect, especially those at word edges. The third aspect pertained to the comprehensive discussion of stress system and foot construction in NNA, which provided additional insights on the stress assignment rules under Metrical Stress Theory. An OT analysis was developed and presented to account for each of these three aspects in the language.

The aim of this chapter is to reiterate the major phonological topics covered and to summarise the main findings that have been discussed in this thesis. The rest of this chapter is organised as follows. Section 6.2 provides a general summary of the previous chapters and sheds important light on the major points. Finally, section 6.3 concludes the thesis and offers some recommendations for future research.

6.2 Thesis Summary

This thesis has explored and analysed some phonological aspects in NNA under the tenets of Optimality Theory (OT). Chapter One provided general preliminaries about the geographical and social background of NNA. The phonemic inventory was given including consonants and vowels with special attention given to the differences between NNA and CA. It also illustrated the significance of this study. Furthermore, research questions were conducted in order to be addressed throughout the thesis followed by the source of the data used in the thesis. Lastly, the organisation of the whole thesis was offered.

In Chapter Two, it was fundamental to show the importance of the syllable in phonological theory involving the internal structure of syllable and to introduce the assumed theoretical frameworks in the current study. Specifically, I focused primarily on four theories: Moraic

Theory, Prosodic Theory, Metrical Stress Theory, and Optimality Theory (OT). Moraic theory was employed as a basic unit of syllable weight to recognise three weights of syllable: light, heavy, and superheavy. The implementation of this theory was expanded to account for other phonological phenomena. For example, stress assignment in NNA is mainly based on moraic theory since stress often lodges on a bimoriac syllable in the word. Prosodic theory is correlated with the notion of word minimality. The prosodic hierarchy proposed by (Selkrik 1980) is composed of three levels: feet, syllable, and mora. Each prosodic word must minimally contain a foot, and a foot must constitute maximally disyllabic and minimally bimoraic (McCarthy and Prince 1986). Metrical stress theory is built on both moraic theory and prosodic theory. This model was utilised as an analytical vehicle to account for stress systems in NNA. The concept of parsing was a basic principle in the theory, and it was utilised as the device by which syllables are grouped into feet and one foot is always eligible to stress assignment in NNA. The last adopted theory was OT which was utilised as the core framework in the analysis of the various phonological phenomena in the current study. All the previous theories and principles were translated into specific constraints under OT that were in line with our analysis throughout the thesis.

Chapter Three presented and discussed the syllable structure types and syllabification patterns in the language, with special focus given to final and non-final superheavy syllables. It was found that NNA shares some commonalities with CA in terms of syllable structure inventories. Nevertheless, NNA tolerates more syllable structure types compared to CA. NNA has twelve syllable types with three different syllable weights: light, heavy, and superheavy. Regarding syllabification patterns, it was shown that CV, CVV, CVC, and CVG sequences are prosodically monomoraic or bimoraic, and they adhere to the bimoraicity status which is the maximal permissible weight per syllable in the language. On the other hand, superheavy CVCC syllables were limited to occur word-finally, however superheavy CVVC and CVVG syllables occurred both word-internally and word-finally. It should be highlighted that some internal CVVC syllables resulted from the process of high vowel deletion or epenthesis when the stem is morphologically concatenated. Also, vowel epenthesis is invoked to create medial superheavy CVCC syllables in the language. As for CVVG syllables, they always occur in heterosyllabic contexts after suffixation and all forms surface faithfully with no repair strategies in NNA.

It has been assumed that all superheavy syllables are bimoraic in NNA, and thus they assign an outright violation of the top high-ranked constraint *3μ which prohibits trimoraic syllables in the dialect. On that account, Hayes (1989, 1995), Broselow (1992), Kenstowicz (1994), Kiparsky (2003), and Watson (2007) suggested various approaches to treat final and non-final superheavy syllables of the forms CVVC, CVCC, and CVVG to motivate the ban on trimoraic syllables in question. To this end, in a word-final position, the leftmost coda of superheavy CVVC and CVCC syllables are considered as extrasyllabic to obviate trimoraicity. Thus, extrasyllabicity is confined to the coda and the geminate of superheavy CVVC, CVCC, CVVG syllables in a word-final position since it satisfies the peripherality condition (Hayes 1995). In a word-internal position, the last segment of superheavy CVVC and CVVG syllables applied the mora sharing rule in which the last segment shares a mora with the preceding vowel in order to avoid trimoraic syllables. This approach is limited to the coda and the geminate consonant of internal CVVC and CVVG syllables in order to satisfy the Strict Layering Hypothesis (SLH) and the constraint LICENSE-μ (Broselow 1992, Watson 2007).

It is noteworthy to mention that no phonological processes were implemented to avoid non-final superheavy CVVG syllables without exceptions. Thus, a research question that has been addressed in this chapter of does NNA always avoid some internal superheavy syllables and how. Despite the fact that NNA allowed only non-final superheavy CVVC and CVVG syllables to surface, however some non-final superheavy CVVC and CVCC syllables were avoided after suffixation. This avoidance can be achieved via vowel epenthesis and/or onset maximisation as repair strategies in order to avoid trimoraicity. The OT analysis demonstrated that the interaction between faithfulness and markedness constraints can significantly explain the characteristics of syllable inventories in NNA. These constraints are universal, but they are ranked on a language-specific basis. For instance, the markedness constraint ONS is ranked higher because onsetless syllables are banned in the language. In the analysis of syllabification patterns, the constraint *3μ is high-ranked, and it must be respected in order to retain the bimoraicity condition for all syllables in NNA. As previously mentioned, superheavy non-final CVVC and final CVCC syllables are avoided through vowel epenthesis and/or onset maximisation. In OT approach, the violable constraints DEP-V and *[σ CC are low-ranked constraints to obtain the optimal form in which they lead to respect the high-ranked constraints, especially, the top high-ranked constraint *3μ.

The goal of Chapter Four was to introduce the formation of consonant clusters in both tautosyllabic and heterosyllabic words, with special emphasis on word edge clusters in the dialect. Also, it examined the licit and illicit word edge clusters and provided a plausible explanation to answer the research question of why certain word edge clusters are avoided, and how they are avoided. In a tautosyllabic context, complex onsets and codas are tolerated in NNA, and they can maximally house no more than two consonants. In a heterosyllabic context, coda-onset clusters occur in two adjacent syllables without any restrictions (i.e., SCL). Triconsonantal -CCC- clusters are prohibited in the language due to vowel epenthesis. It has been examined the possible effectiveness of Sonority Sequencing Principle (SSP) on the formation of consonant clusters at word edges. In initial consonant clusters, it was observed that SSP had no restrictions on the occurrence of complex onsets with various sonority profiles. Thus, complex onsets occurred with plateau and falling sonority and no repair strategy were implemented in order to split such clusters. In final consonant clusters, we observed that final consonant clusters obeyed the SSP to some extent. To clarify, in rising sonority, coda clusters violated the SSP and triggered vowel epenthesis in order to remedy such clusters. In falling sonority, complex codas adhered to the SSP, and no repair strategies are invoked. What was unusual about plateau sonority is that coda obstruent clusters violated the SSP, and no repair strategy was employed to avoid the SSP violation, such as /nafs/ ‘soul’ → [na**fs**]. However, coda nasal clusters were resolved with an appropriate vowel in order to split the final consonant clusters such as /samn/ ‘ghee’ → [sa.m**i**n]. We assumed that SSP did not provide an explicit explanation for why an epenthetic vowel was applied to coda nasal clusters but not to coda obstruent clusters. To this end, we revealed that splitting coda nasal clusters is ascribed to the idea that sonorants (nasals) require a vowel to their left in the dialect, not because they violate the SSP.

I revealed that some complex onsets and codas were avoided through certain phonological processes other than the SSP restrictions. In forbidden complex onsets, I concentrated only on the obstruent coronal clusters including stops, fricatives, and affricates. It was shown that such clusters were avoided through two phonological processes, namely underlying high vowel preservation and gemination. To be more specific, potential obstruent coronal onset clusters were avoided in monomorphemic forms via what I termed ‘underlying high vowel preservation’ in order to prevent such clusters to surface in the language. As for bimorphemic forms, it was noted that some onset clusters formed from the prefix [-t] and a stem-initial consonant. These clusters appealed to gemination as a result of a regressive assimilation in order to ban obstruent coronal onset clusters. In forbidden complex codas, it was revealed that some bimorphemic coda clusters were avoided via gemination. All examples were suffixed by the verbal -t ‘you’ and attached to the identical or near identical a stem-final consonant. Thus, all the bimorphemic forms emerged from a progressive assimilation, as opposed to prohibited onset clusters, in which the suffix -t assimilates to a stem-final consonant.

All in all, we found that some peripheral consonant clusters could not be fully interpreted by the SSP since some of these clusters violated this principle and were still permitted to surface in NNA. Thus, we assumed that these clusters had co-occurrence governed by the Obligatory Contour Principle (OCP) (Leben 1973, McCarthy 1986, Odden 1986), which banned identical adjacent feature specifications, (i.e., coronal obstruents). Two OCP constraints were formalised in order to account for the prohibition of such clusters under the effect of OCP in question. Under OT, in the permissible word edge clusters, the faithfulness constraint DEP-V outranked the constraints *[σ CC and *CC] σ in order to rule out any candidate that tolerates vowel epenthesis to split a well-formed cluster. In the forbidden word edge clusters, two OCP constraints were proposed and considered to be undominated constraints in order to eliminate any candidate that emerges with forbidden complex onsets and codas due to the effect of OCP. Finally, in medial triconsonantal clusters, the inviolable constraint *-CCC- was undominated in order to disallow internal -CCC- clusters surfacing in the language. However, the faithfulness constraint DEP-V was ranked below to allow the optimal candidate to insert a vowel to break up such clusters.

Chapter Five devoted at exploring and analysing the stress system and foot construction in NNA. Syllable weight and position have played a significant role in determining the location of the potential stressed syllable within content words. Thus, NNA is characterised as a quantity-sensitive dialect in which the distribution of stress is predictable and rule-governed. The main stress is confined to a three-syllable window in the prosodic word. In trisyllabic words, superheavy syllables always attract stress. In the absence of superheavy syllables, the stress is placed onto a non-final heavy syllable. In the absence of heavy syllables, the stress is placed to the leftmost CV syllable. Otherwise, with more than trisyllabic words, a penult light syllable attracts stress when it is flanked by light syllables. In the analysis of foot construction, NNA is a trochaic right-oriented system with the effect of End Rule Right (ERR), where the stress is assigned to the head of the rightmost visible foot in the prosodic word. Under Metrical Stress Theory (Hayes 1995), I have adopted some parameters and principles to account for stress assignment and foot construction under the tenets of OT. It was shown that the analysis of stress assignment and foot construction were based on ternary alternation under the pressure of the weak local parsing principle. This principle assumes that a light syllable is skipped over when it is trapped between two bimoraic syllables to avoid a stress clash. Thus, a stress clash was observed as a result of the interaction between the constraints PARSE-SYL on one side, and *CLASH and the maximal foot size constraint FT-BIN on the other. In case of a stress clash, PARSE-SYL is violated to satisfy the undominated constraints *CLASH and FT-BIN. However, with no stress clash, the parameter of persistent footing was applied, and the constraint PARSE-SYL should be satisfied. A family of alignment constraints were employed to account for the word-initial stress, directionality, and the End Rule Right (ERR). For instance, directionality of footing was interpreted by the interaction between the foot alignment constraints, where the constraint ALL-FT-LEFT is ranked higher than ALL-FT-RIGHT since parsing starts from left to right. Thus, the foot alignment constraint ALL-FT-LEFT is violated when each foot is not aligned to the left edge of the word. The high-ranked ALL-FT-LEFT constraint leads to the correct selection of the head foot alignment, where the constraint RIGHTMOST selects the rightmost foot over the leftmost foot to receive the main stress in the language.

Remember that stress is always assigned to the rightmost non-final visible foot in the word. However, it has been revealed that NNA showed an unusual behaviour of non-final CVC syllables in stress assignment. It was observed that non-final CVC syllables attract stress when it is the only heavy syllable presented in the word. However, in the presence of geminates or long vowels CVG or CVV, non-final CVC syllables fail to assign stress when it is preceded by CVG/CVV syllables, even though it is positioned and footed in the rightmost non-final syllable of the prosodic word. This case is attributed to the syllabic weight source either a distinctive intrinsic prominence or a coerced extrinsic prominence (Morén 1999, 2003). The former weight type represents non-final CVG/CVV syllables because they are inherently bimoraic since geminates and vowels are always moraic as opposed to singleton coda consonants. The latter weight type represents non-final CVC syllables because they are underlyingly monomoric since coda consonants are forced to be moraic only by the enforcement of WBP. Under this view, non-final CVC syllables are treated as weight-based constraint interactions, whilst CVG/CVV syllables are treated as a prominence-based constraint represented by PK-PROM. The constraint PK-PROM determines the degree of heaviness based on a scale of weight hierarchy, distinguishing between heavy CVG/CVV syllables and non-final CVC syllables according to their prominence rather than foot structure. Thus, the high-ranked constraint PK-PROM outranked the constraint RIGHTMOST in order to optimise the most prominent syllable rather than the rightmost non-final visible foot in the word. Under this analysis, I argued that NNA has a binary stress system with the effect of ternary alternations and syllable prominence resulting from constraint interactions and scalar quantity-sensitivity. Finally, our stress analysis assumed two independent devices, a foot-driven stress device and a prominence-driven stress device, to account for one stress system in NNA. Therefore, the two analyses seem to be peculiar which are left for future work to reconcile these two devices.

6.3 Conclusion and Future Research

This chapter has offered a general summary of the whole thesis. One of the major accomplishments of the current study is its enhancement and contribution to the general understanding of the field of phonology and the phonology of NNA in particular. These basic objectives have been attained by providing a formal analysis of diverse phonological phenomena for new and systematic data sets of NNA under the tenets of OT and other related theories. NNA has never been the subject of linguistic analysis in the framework of OT before. Thus, investigating and examining certain phonological aspects of NNA has enriched the body of linguistic research in relation to Arabic phonology and dialectology. The current study may be considered the starting point for further studies on various phonological phenomena and other relevant sub-disciplines related to the investigated dialect.

As previously mentioned, Najdi Arabic (NA) and its subdialects are less-investigated Arabic varieties and have not received a great deal of attention in linguistic domains, including the field of phonology in general and the various approaches of OT specifically. Hence, NNA can be considered fertile ground for future research. Although we have explored and investigated several phonological aspects of NNA, there are various other remarkable aspects in the phonology of NNA that have not been covered in the thesis and left for future studies due to time and space limitations. It is therefore worth mentioning some recommendations for future research. An issue that has not been studied is the morphonological phenomena at the derivational level rather than at the word level only (lexical vs. postlexical), such as stress assignment and stress shift, vowel syncope, vowel epenthesis, and the status of final and non-final superheavy syllables within the framework of stratal OT. For example, stress placement is shifted at the phrasal level, when some nouns are pluralised, as in /ˈtˤa:w.lah-a:t/ 'tables'→ [tˤa:w.ˈla:t]. More to the point, vowel epenthesis and syncope are seen after derivational environments. For example, the words /dʒalas-at/ 'sit (fem.)' → [dʒlisat] and /ʕam:-na/ 'our uncle' → [ʕam.ma.na] undergo vowel epenthesis and syncope after derivational levels. Also, some superheavy syllables become heavy after derived environments. An example is the word /ʔiχt-kam/ 'your (fem. pl.) sister' → [ʔiχ.ti.kam], where the last consonant in the superheavy syllable CVCC is resyllabified into the onset of the following syllable and vowel epenthesis is applied to affiliate it with the syllable.

Further studies can also account for the same phonological topics in the framework of OT for the sake of comparing Northern Najdi Urban Arabic with Northern Najdi Bedouin Arabic within the same region and tribe (Shammar tribe). Moreover, I suggest that an acoustic experiment is required to provide further evidence on what has been found in NNA and see if it is similar or not. Another issue that deserves to be investigated in the future is the status of emphatic consonants and their effects on adjacent sounds, a phonological process referred to as emphasis spread or pharyngealisation. Finally, I hope this thesis will motivate scholars to conduct more studies into Najdi Arabic and its subdialects in specific, and other contemporary Arabic varieties that have not given a great deal of attention in the phonological literature in general.

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Appendices

Appendix A

LIST OF OT CONSTRAINTS

ALL-FT-RIGHT (McCarthy and Prince 1993)

Assign one violation for every syllable that intervenes between the foot and the right edge of the prosodic word.

ALL-FT-LEFT

Assign one violation for every syllable that intervenes between the foot and the left edge of the prosodic word.

ALIGN-PRWD-LEFT

Every PrWd begins with a foot.

ALIGN-PRWD-RIGHT

Every PrWd ends in a foot.

***σ[CCC** (McCarthy and Prince 1995)

A sequence of syllable-initial triconsonantal clusters is not allowed in the output.

***-CCC-**

A sequence of internal three consonant clusters is not allowed in the output.

***CLASH** (Kager 1999)

No stressed syllables are adjacent.

***COMPLEX^{ONS} *[σ CC**

Onsets are simple.

***COMPLEX^{ONS} *[σ CC**

Onsets are simple.

***COMPLEX-G**

No tautosyllabic geminates in multisyllabic words.

***CODA** (Prince and Smolensky 2004)

Assign one violation for each syllable which has a coda.

CODA SONORITY SEQUENCE (CODASONSEQ) (Clements 1990)

Coda clusters with rising sonority are not allowed.

CULMINTIVITY (CULM) (Hayes 1995)

Every prosodic word has one and only one primary stressed syllable.

***Cunsyll**

Unsyllabified coda consonants are prohibited word-finally.

DEP-IO (McCarthy and Prince 1995)

Assign one violation for each segment in the output which does not have a correspondant in the input. (No epenthesis)

DEP-V (McCarthy and Prince 1995)

Output vowels must have input correspondents.

***FINAL-G**

Word-final geminates are prohibited in multisyllabic words.

***FINAL-Cμ**

One final consonant is weightless in a syllable-final position.

Foot Binarity (FT-BIN) (Prince and Smolensky 1993)

Feet are binary at some level of moraic or syllabic analysis.

***i]σ** (Kenstowicz 1996)

High short unstressed vowels in open syllables are not allowed.

IDENT-ROOT-FEATURE (McCarthy and Prince 1995)

Every feature of a root's input has a correspondent in the output.

IDENT(long)

A long vowel in the input is realised as long in the output.

***3μ** (Kager 1999)

Trimoraic syllables are not allowed.

LEFTMOST (McCarthy and Prince 1993/2004, Kager 1999)

The head foot is leftmost in PrWd.

MAX-μ

Every mora in the input has a correspondent in the output.

MAX-C

Input consonants must have output correspondents.

MAX-V

Input vowels must have output correspondents.

MAX-μ-V

Every vocalic mora in the input has a correspondent in the output.

MAX-V

Input vowels must have output correspondents.

MAX-IO

Assign one violation for each segment in the input which does not have a correspondant in the output. (No deletion)

MAX-V& UNIFORMITY

Violations of MAX-V and UNIFORMITY cannot apply to the same word.

NONFINALITY (NON-FIN) (Prince and Smolensky 1993/2004)

The head foot of the PrWd must not be final.

NOSHAREDMORA (NSμ)

Moras in the output are linked to a single segment.

NUC

Assign one violation for each syllable which does not have a nucleus.

OCP-Cor[-son][-cont] (Morelli 1999)

Assign one violation for any two consonants with the features [+Cor, -Cont] which are adjacent in an onset.

OCP-Cor[-son][-strid]

Assign one violation for any two consonants with the features [+Cor, -Strid] which are adjacent in the output of the onset.

OCP-Nasal

Assign one violation for any two consonants with the features [+Son, -Cont] which are adjacent in the output of the coda.

***ONSET-μ** (Hayes 1989, 1995)

Onsets are not moraic.

ONS

Assign one violation for each syllable which does not have an onset.

PEAK-PROMINENCE (Pk-PROM) (Prince and Smolensky 2004, Kager 2007)

Peak(x) is more harmonic than Peak(y) if |x| > |y|.

PARSE-SYL (McCarthy and Prince 1993)

All syllables must be parsed into feet in a prosodic word.

RHTYPE=T (Prince and Somlensky 1993)

Feet have initial prominence (left-headed).

RHTYPE=I

Feet have final prominence (right-headed).

RIGHTMOST

The head foot is rightmost in PrWd.

***SYLLFIN-L** (Bamakhramah 2009)

An ultimate syllable cannot be light.

UNIFORMITY

No element of the output has multiple correspondents in the input. (No coalescence)

WEIGHT-BY-POSITION (WBP)

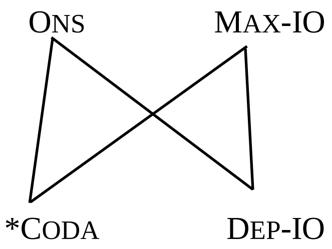
Coda consonants are moraic in a non-final word position.

Appendix B

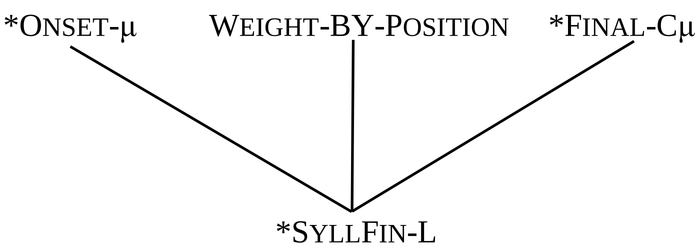
Final Constraint Ranking for Some Phonological Phenomena in NNA

Chapter Three:

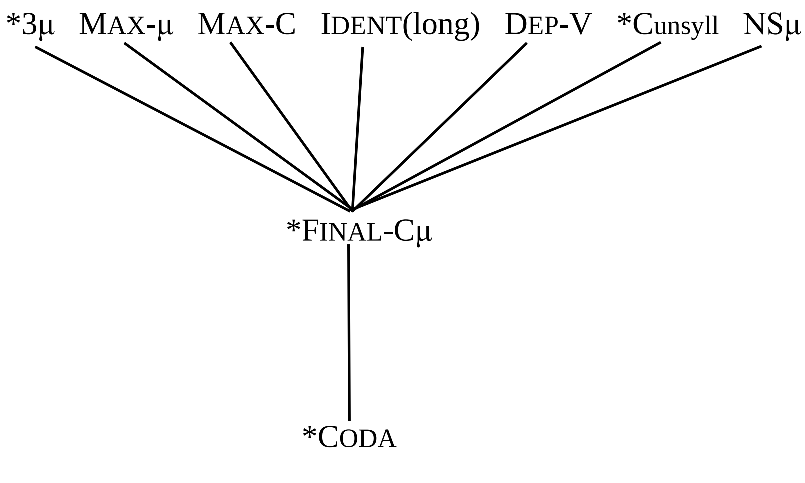
1. General constraint ranking for basic syllable structure inventory



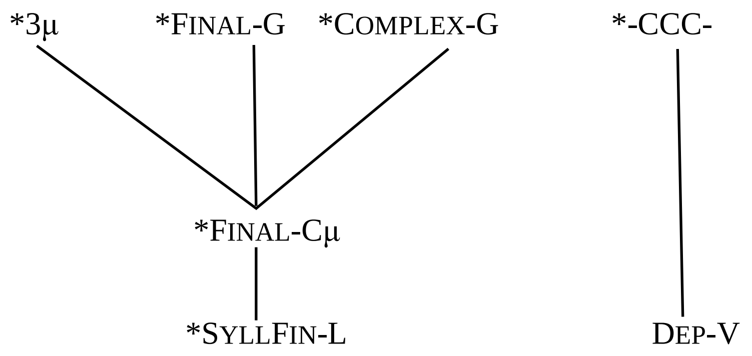
2. Overall constraint ranking for final and non-final CVC syllables



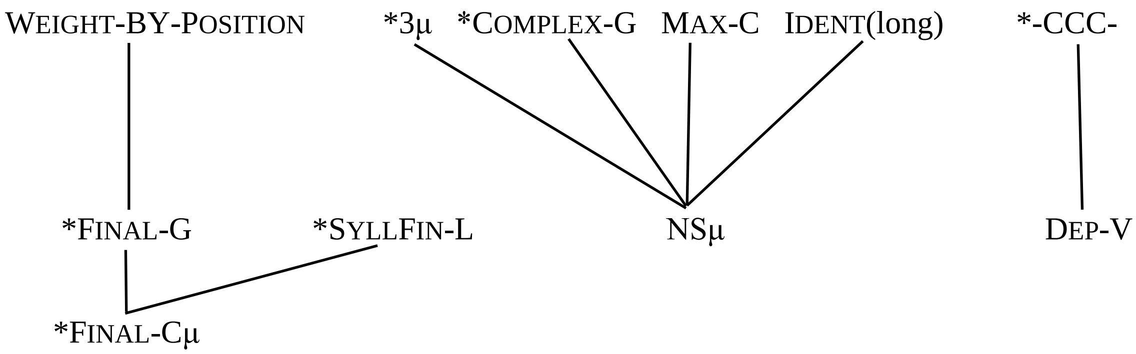
3. The summary of unified constraint ranking for CVVC and CVCC syllables word-finally



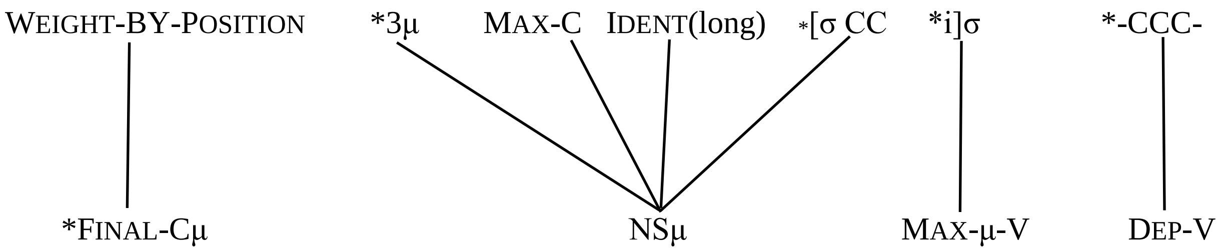
4. Overall constraint ranking for final and non-final heavy CVG syllable



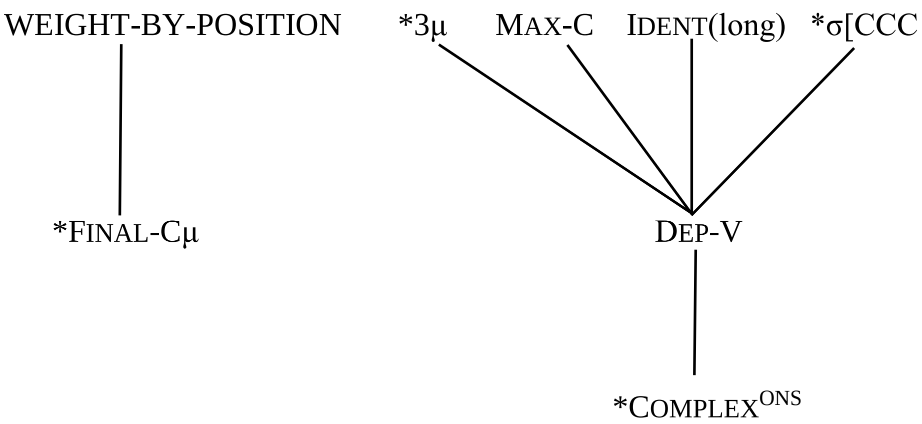
5. Summary constraint ranking for non-final superheavy CVVG syllables



6. Summary constraint ranking for non-final superheavy CVVC syllables

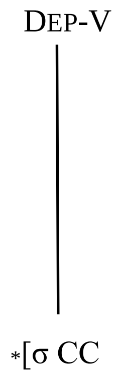


7. Summary constraint ranking for the avoidance of non-final CVVC and CVCC syllables

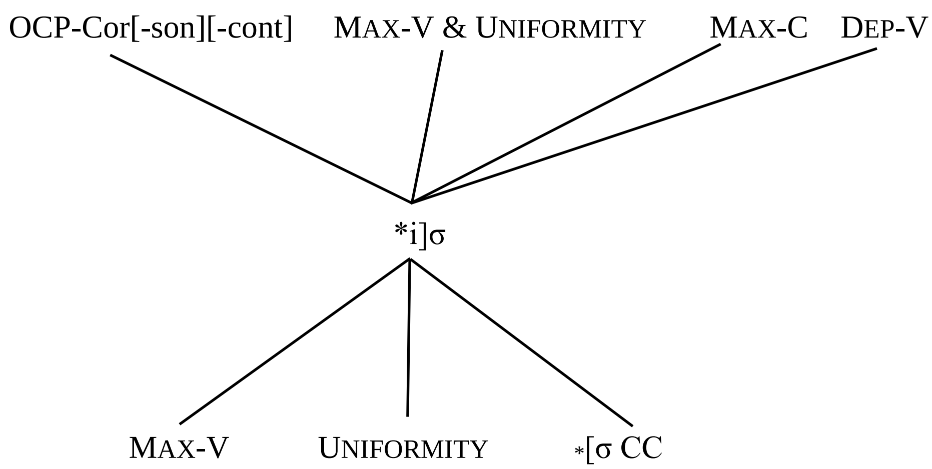


Chapter Four:

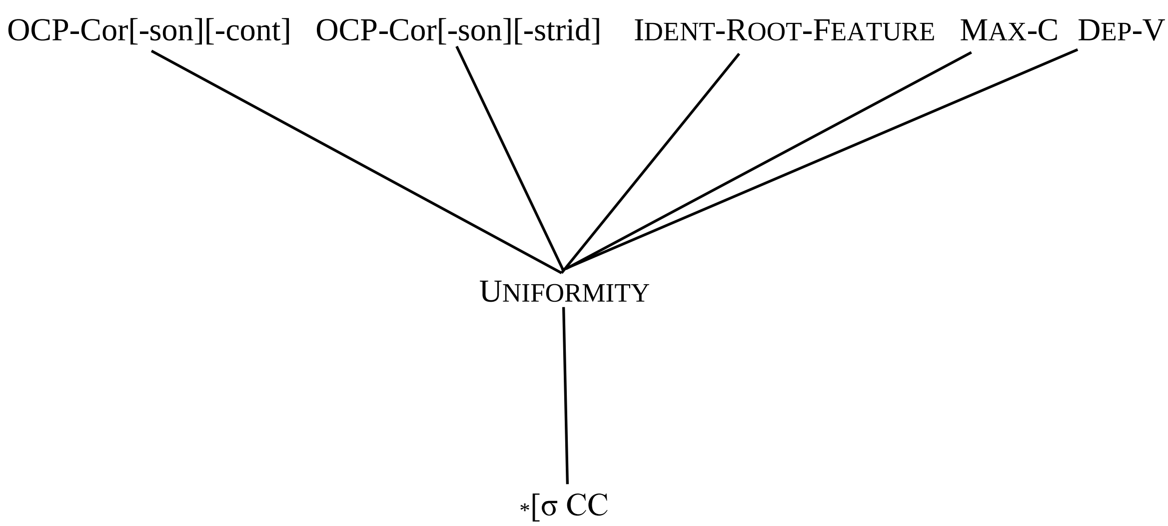
1. Summary constraint ranking for allowable onset clusters



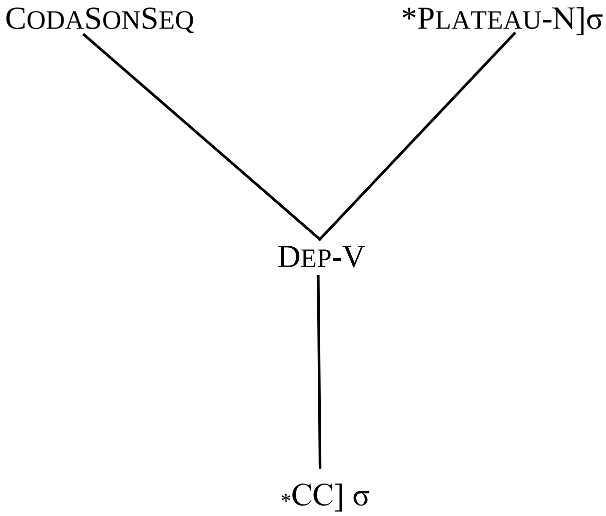
2. The combined constraint ranking of forbidden monomorphemic complex onsets



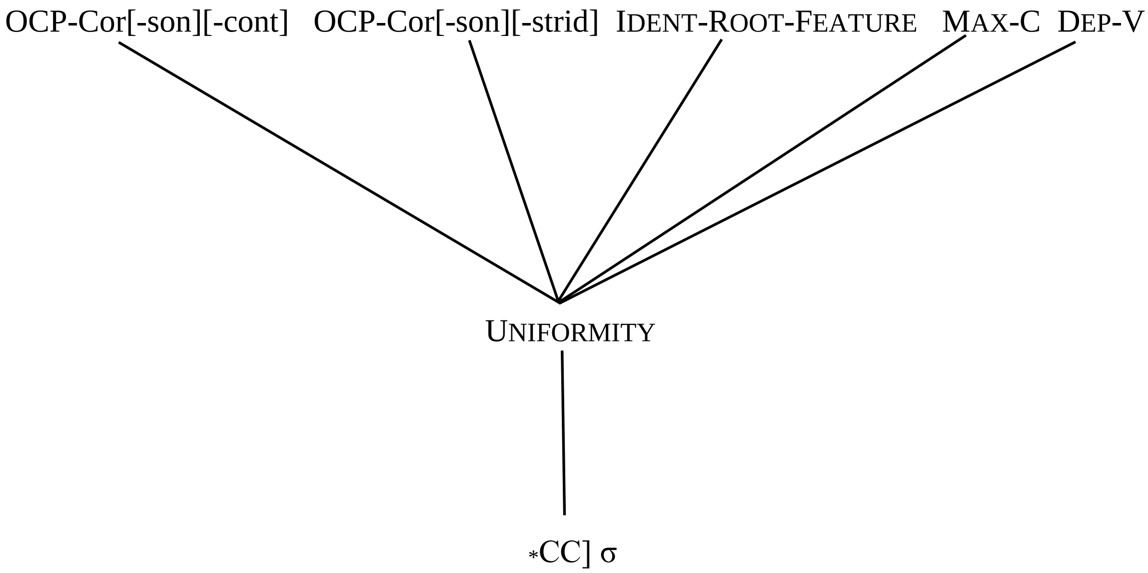
3. Summary of constraint ranking for forbidden bimorphemic complex onsets



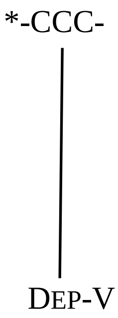
4. Summary of constraint ranking for prohibited monomorphemic complex codas



5. Summary of constraint ranking for forbidden bimorphemic complex codas

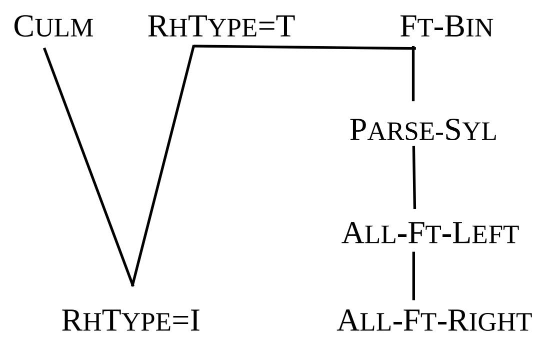


6. Summary of constraint ranking for the ban on internal -CCC- clusters

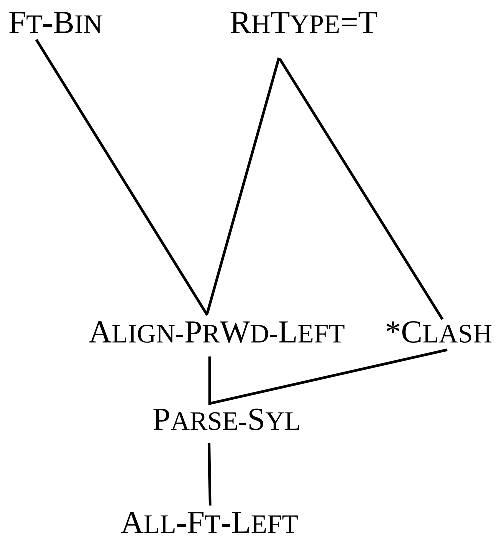


Chapter Five:

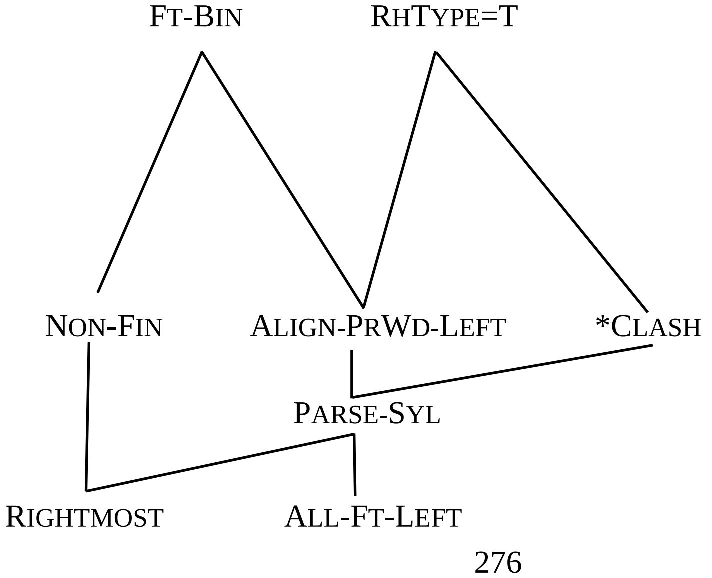
1. General constraint ranking for stress assignment



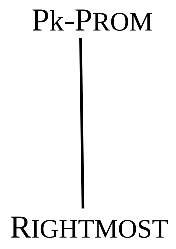
2. General constraint ranking for foot construction



3. Overall constraint ranking for foot construction



4. General constraint ranking for prominence-driven stress



5. Final constraint ranking for stress assignment and foot construction in NNA