

SYLLABLE STRUCTURE AND PHONOLOGICAL PROCESSES OF SOUTHERN NAJDI
ARABIC: AN OPTIMALITY-THEORETIC MODEL

by

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A Dissertation Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
in Linguistics

at

The University of Wisconsin-Milwaukee

May 2022

ABSTRACT

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The University of Wisconsin-Milwaukee, 2022
Under the Supervision of Professor Anne Pycha

This dissertation provides a theoretical analysis of the syllable structures and vowel processes in an understudied dialect, Southern Najdi Arabic (SNA). Using the dialect's unique phonological characteristics, the analysis aims to contribute to a better understanding of the phonological representations of syllables and common processes in Arabic dialects and to shed light on some of the longstanding problems in the literature. Presented within the model of Optimality Theory (OT), the dissertation offers a unified account for syllabification patterns and related phenomena, such as vowel raising, syncope (high vowel deletion, trisyllabic elision, and feminine suffix vowel deletion), CV metathesis, epenthesis, and stress patterns. While this dialect resembles the neighboring Najdi and Bedouin dialects, it also shows differences not previously reported in the literature. These differences are highlighted in the greater tolerance of superheavy syllables in non-final position and special sonority requirements presented by a unique type of epenthesis. The dialect also appears to allow trimoraic syllables and shows distinct stress patterns. These differences are accounted for using metrical constraints in OT. Lastly, the dialect presents a great deal of opacity when two or more phonological phenomena co-occur. These issues are accounted for with Stratal OT, a constraint-based approach to the phonology-morphology interface.

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ACKNOWLEDGMENTS

{وقل ربي زدني علماً} طه ١١٤

{And Say: My Lord, increase me in knowledge} Quran, 20:114

This dissertation would not have been accomplished without the contributions of many people to whom I am greatly indebted.

First and for most, I would like to express my profound appreciation and gratitude to my academic supervisor Professor. Anne Pycha. I have had the privilege to work with Prof. Pycha for the past few years, and during this time, I have gained a lot of experience from her teaching and research knowledge. She has been so inspiring and encouraging and she has always been committed to push me to do my best. Throughout the development of this manuscript, her valuable comments and feedback have greatly polished the shape of this dissertation. I am greatly thankful to Dr. Pycha for her continued support and proper guidance for me throughout my graduate studies at the University of Wisconsin- Milwaukee.

My gratitude is also extended to the advisory committee members: Professor. Gary Davis, Dr. Jae Song, and Dr. Hamid Ouali. Their feedback on this dissertation as well as on smaller projects in advanced level classes and seminars were so significant for developing my research knowledge.

I am deeply indebted to my parents who always supported me and believed in me from day one. I am indebted to my dear brothers and sisters, and I owe Abdulrahman a great one. Special thanks are also due to my dear friends here in the US and in Saudi Arabia, as well.

Last but not least, I would like to express very special gratitude to the special company in this long challenging journey, my wife Hissah, my son Tamim, and my little daughter Nourah.

My wife has been so patient with me, and this project won't see the light without her patience and sacrifices. I would never take that for granted and I promise I will try my best to make it up to her as well as to our kids in the days yet to come.

Chapter 1: Preliminaries

1.1 Introduction

Najdi is one of the most common Arabic dialects in the Arabian Peninsula, spoken in the region of Najd in central Saudi Arabia, which covers nearly a fourth of the country's land mass and is inhabited by roughly a third of the national population thanks to the capital city of Riyadh. Historically, Najdi, among other Arabic vernaculars, were viewed by Old Grammarians as derived from Classical Arabic, categorizing reported differences between dialects in prescriptivist terms as acceptable, neutral, or unacceptable (Watson, 2011). Modern vernaculars of Arabic have drawn considerable attention from linguists. In the past half century, Najdi Arabic has been examined by numerous researchers, such as Abboud (1979), Alessa (2008), Alghmaiz (2013), Al Motairi (2015), Al-Qahtani (2014), Alrojaie (2013), Al-Solami (2020), Al-Sweel (1987, 1990), Alezets (2007), Holes (1990, 1991), Ingham (1982, 1986, 1994), Johnstone (1963, 1967b), Kurpershoek (1999), Lehn (1967), and Prochazka (1988).

Despite the wealth of phonological literature on Arabic dialects in general, and Najdi dialects in particular, some parts of Najdi remain underreported. According to Ingham (1994), Najdi Arabic encompasses a group of three regional dialects: Northern, Central, and Southern Najdi.¹ While these dialects have many similarities, they can be distinguished by their morphology and phonology. This dissertation sheds light on one of these dialects, Southern Najdi Arabic (SNA). It shows that SNA differs from Central and Northern Najdi Arabic in several aspects. First of all, SNA appears to have unique syllabification patterns. In particular, it shows a greater tolerance for all possible syllable types in word-final and internal positions. That

¹ Ingham (1994) pointed out four groups with the addition of mixed Northern-Central dialects, but in his description maintained three regional groups only.

is, SNA allows superheavy CVXC syllables (X stands for either a consonant or a vowel) in word non-final position, which is more restricted in most Arabic vernaculars.

Second, SNA appears to provide a more elaborate chain shift in vowel processes, as proposed by Kirchner (1996) and developed by McCarthy (1999, 2003). This chain is recognized by the pattern that goes along the scale [a] > [i], [u] > Ø. Under this assumption, vowel raising and vowel syncope may be understood as a single phenomenon. Raising and syncope are also involved in the formation of several opaque structures that arise in SNA. I review non-true surface forms in certain vowel processes and stress patterns and investigate how different phenomena may interact with one another. I show that some interactions can lead to opaque structures, such as low and high vowel syncope and sonority-induced epenthesis.

Third, SNA presents some challenges to a well-documented phenomenon known as guttural low vowel metathesis. While most descriptive works characterize this phenomenon as a synchronic metathesis, I show that guttural metathesis in SNA is actually the result of two independent changes: epenthesis and deletion. This approach is supported by forms that undergo epenthesis but not syncope in Nadji and other Arabic dialects, whereas the alternative approach (metathesis) treats such forms as either exceptions or unrelated to the phenomenon.

Finally, another unique characteristic of SNA is its enforcement of the Sonority Sequencing Principle (SSP). In the phonological literature, the SSP requires that syllable nuclei, which are typically vowels, constitute a sonority peak; furthermore, onset clusters must have rising sonority, and coda clusters must have falling sonority. Unlike most Bedouin dialects, SNA not only enforces SSP on codas of monosyllabic CVCC words but also on CC.C coda clusters in medial position, as demonstrated by vowel epenthesis. These differences are crucial for understanding Arabic phonology in general and syllabification patterns in particular because they

are not covered in previous typologies of Arabic dialects, such as Kiparsky (2003). In sum, the goal of this dissertation is to examine phonological processes that impact syllable structures in SNA and provide insights for future analysis of other Bedouin dialects that may display similar phenomena.

Some of the challenges presented by an analysis of SNA are not unique. Indeed, Arabic phonology exhibits several interesting characteristics that recur across dialects. In most modern dialects, superheavy syllables ending in VCC or VVC appear to have a special status; most dialects avoid such syllables in non-final position, but in certain dialects, some types of superheavy syllables may be tolerated. An ongoing question is the status of superheavy syllables when they appear in a given language and the phonological status of their final coda consonants, which have been variously treated as extrasyllabic, degenerate, semisyllables, or shared moras.

An important gap in the literature on Arabic phonology concerns the motivation for vowel processes, specifically those that affect light syllables. Most works on Bedouin dialects, including Najdi, have described different vowel processes that affect light syllables, such as low vowel raising, high vowel deletion, and trisyllabic elision, Bedouin Hijazi Arabic (Al-Mozainy, 1981), Najdi Arabic (Abboud, 1964, 1979; Al-Solami, 2020; Al-Sweel, 1981; Al-Qahtani, 2014; Ingham, 1994), Bedouin dialects of Arabia (Ingham, 1982; 1994; Prochazka, 1988), and Bani Hassan (Irshied, 1984). Though each appears to target a certain type of input, the motivation for each process is not well justified.

A few previous researchers have attempted to unify the processes that affect light syllables. Using a constraint-based perspective, Kirchner (1996), Gnanadesikan (1997), and McCarthy (1999, 2003) attributed the light vowel processes to a vowel chain shift, which requires a vowel duration reduction, including reduction to zero duration (\emptyset). Within this same

framework, McCarthy argued an iambic foot structure was also required. However, SNA poses a challenge to that approach since not all sequences of underlying low vowels delete the first vowel. Furthermore, if iambic stress is the factor, even sequences of non-low vowels should behave similarly, which is not the case. Therefore, a thorough reanalysis is necessary to account for trisyllabic elision and other syncope processes.

In analyzing the phonological processes in SNA, I discuss stress patterns, the role of morphology, and how phonological and morphological representations interact and give rise to opaque structures. These types of interactions are best examined within lexical phonology (Booij & Rubach, 1987; Kaisse & Shaw, 1985; Kiparsky, 1982, 1985; Mascar, 1976; Rubach, 2008), which assumes the relationship between morphology and some parts of phonology are represented in the lexicon. Therefore, phonological processes are divided into two types: lexical and post-lexical. I show that some phenomena, such as epenthesis, and some types of syncope in SNA must be represented in the post-lexical phonology. Additionally, I show that at the lexical level, there are hierarchal levels represented by the core level, which is the stem, and then the word level.

This study adopts the constraint-based model Optimality Theory (OT), as it possesses several advantages over rule-based frameworks. One is its matching output to input forms based on universal constraints. The core principle of OT is violability, which helps determine optimal candidates; any violation arising from interaction between constraints can be accounted for by a set of inviolable surface constraints. Another advantage is the connection between a structural change and the environment that gives rise to that change (Prince & Smolensky, 1993), particularly when it comes to the overall structure of the word. In SNA, for instance, the process of syncope not only looks at the structure of the syllable but also at its intrinsic properties and

neighboring syllables (e.g., an open syllable next to another open syllable). Furthermore, OT has been argued to solve long-standing issues in the field of phonology, such as the conspiracy problem defined by Kisseberth (1970). In this context, a “conspiracy” is when a single phonological principle gives rise to one or more “repairs” or block repairs to avoid ill-formed structures. According to Kisseberth and many others, generative phonology fails to solve this problem.

Taken together, the reanalysis offered in this dissertation contributes to our understanding of SNA syllable structure and related phenomena. The following sections provide background on Najdi dialects and explain the common syllable structure and processes that I will be analyzing in subsequent chapters of the dissertation. Section 1.2 presents a phonological background on SNA and some phonological concepts, Section 1.3 introduces OT, and Section 1.4 discusses challenges created by opacity and evaluates OT models that address this phenomenon. Finally, Section 1.5 demonstrates that a special version of OT known as Stratal OT is more adequate to describe opaque structures.

1.2 Phonological Background on SNA

1.2.1 Consonants and Vowels

Tables 1 and 2 display the vowel and consonant inventories of Najdi Arabic, which are similar to Classical Arabic (Ingham, 1994; Johnstone, 1963).

Table 1

Vowel Inventory of Najdi Arabic

	Front	Central	Back
High	i, i:		u, u:
Mid	e:		o:
Low		a, a:	

Table 2

Consonant Inventory of Najdi Arabic

	Labial	Labio-dental	Interdental	Alveolar	Alveolo-palatal	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive (Emphatic)	b			t, d t ^ʕ			k, g			ʔ
Fricative (Emphatic)		f	θ, ð ð ^ʕ	s, z s ^ʕ	ʃ			χ, ʁ	ħ, ʕ	h
Affricate			ts, dz		dʒ					
Nasal	m			n						
Liquid				l, r						
Glide	w					j	w			

Unlike Classical or Modern Standard Arabic, Najdi dialects allow mid vowels. In addition, the Classical Arabic uvular stop /q/ is a voiced velar stop /g/, while the emphatic voiced alveolar stop /d^ʕ/ merges with the emphatic voiced interdental fricative /ð^ʕ/.

Finally, the dialects show more complex sounds as interdental affricates are attested. While the interdental affricates /ts/ and /dz/ are best realized as variants of /k/ and /g/, respectively, the data suggest they could be used as different phonemes, particularly /ts/ against /k/ in minimal pairs.

1.2.2 Determining the Underlying Forms

Most formal phonological analyses, including those proposed in this dissertation, map an input (or “underlying”) form on to an output (or “surface”) form. Before analyzing SNA data, it is important to establish how the input form is determined. Many previous analyses of Arabic have assumed that input forms correspond to Modern Standard Arabic forms, and that phonological processes operate to produce the dialectal output. However, there is no reason to believe that this is the correct approach. To begin with, such an analysis makes the flawed assumption that the language which enjoys higher social status should also be underlyingly

“basic” or fundamental for linguistic analysis, which is not the case. Furthermore, most analyses within phonological theory do not require reference to a related dialect, whether standard or not; instead, underlying input forms are determined based on language-internal evidence, and are assumed to contain only those elements which are unpredictable by either rules or constraint rankings.

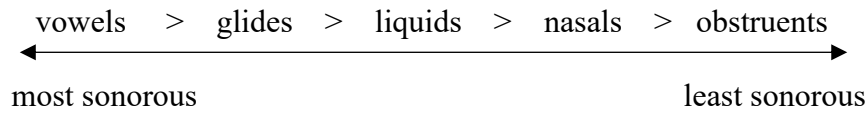
In my analysis, therefore, I have determined input forms based solely on data from SNA, using paradigm comparisons. For instance, the words *maktab-k* ‘your office’ and *mkatib-ih* ‘his office’ share one stem, i.e., *maktab* or *maktib* ‘office.’ Kager (1999a) pointed out that a surface form is assumed to match the underlying form unless there is a reason to believe otherwise. Consequently, a proposed input for the stem would be justified by the direction of the subsequent change: [a] > [i] or [i] > [a]. As will become apparent in the discussion of SNA vowel reduction that occurs throughout this dissertation, my analysis strongly suggests that the former is the only possible explanation. Throughout this work, then, the reader may assume that input forms are specific to SNA, and contain unpredictable elements only; surface forms, which are by definition predictable, are derived by the application of constraint rankings.

1.2.3 Sonority Scale

Since the analysis in this dissertation discusses phenomena associated with sonority requirements, a brief background on sonority constraints is given. Cross-linguistically, consonants and vowels show a hierarchy in terms of sonority, with vowels being the most sonorous and obstruent consonants being the least. Several researchers have attempted to provide a universal sonority scale (e.g., Broselow, 1979; Butt, 1992; Clements, 1990; Hooper, 1976; Selkirk, 1984). According to Clements (1990), obstruents (stops and fricatives) present one class on the sonority scale, as shown in Figure 1.

Figure 1

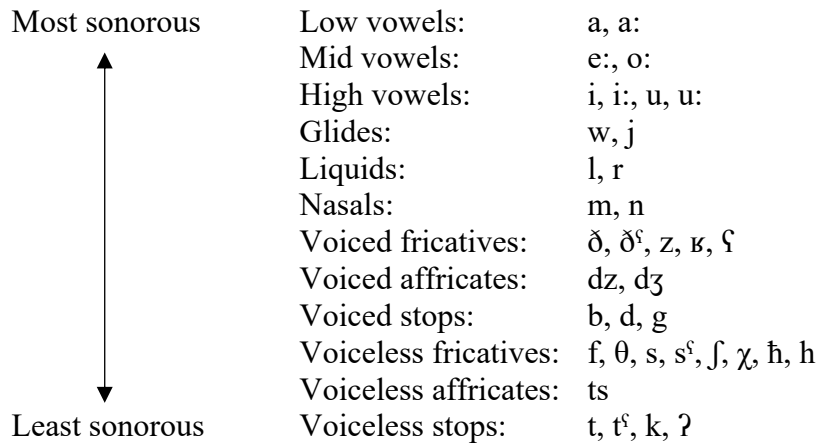
Sonority Scale



The problem with such a scale is that all obstruents and vowels are positioned on the same level of the sonority hierarchy. In contrast, such scholars as Selkirk (1984), Katamba (1989), Butt (1992), and Teifour (1997) have argued that voiced obstruents are more sonorous than their voiceless counterparts. Similarly, Parker (2008) argued for a similar approach, introducing a more complex sonority scale, as demonstrated with Arabic sounds in Figure 2.

Figure 2

Arabic Sonority Scale



As mentioned earlier, the SSP is often invoked to account for the structure of syllables. Specifically, the SSP dictates that a syllable should show the maximal sonority at its peak, which is often a vowel, whereas the edges of a syllable show the least sonority. Clusters should respect this pattern as well, with onsets showing a rise in sonority and codas showing a drop (Clements, 1990).

Which sonority scale should apply to the data in SNA? As far as the data show, neither manner nor voice in obstruent consonants play a role in sonority, as shown in (1).

- (1)
- | | | |
|----|---------|------------------|
| a. | [gʊtʰb] | ‘polar’ |
| b. | [fatg] | ‘a crack/hernia’ |
| c. | [wayχz] | ‘pinch’ |
| d. | [χubz] | ‘bread’ |
| e. | [libs] | ‘clothes’ |
| f. | [katf] | ‘shoulder’ |

If voiced obstruents are more sonorant than their voiceless counterparts in SNA, or fricatives are more sonorant than stops, SNA should exhibit epenthesis in (1), just as it does for any other coda cluster with a rise in sonority: /gabɪ/ > [gabil] ‘before.’ Consequently, the sonority scale in Figure 1 is more representative of the data in SNA. While the SSP generalization is maintained in coda clusters in SNA and other Najdi dialects, the onset clusters appear to violate the principle, an issue that I return to in Chapter 3.

1.3 Background on Syllable Structure and Vowel Processes in Bedouin Arabic

This section describes the syllable structure and related vowel phenomena in Bedouin Arabic dialects and shows the shortcomings of past theoretical analyses of these structures.

1.3.1 Syllable Structure in Bedouin Dialects

Previous research on the typology of Arabic dialects was based on syllabification pattern differences. Dialects were grouped based on where vowel epenthesis occurred next to an unsyllabified segment, usually the second consonant in a medial CCC cluster. Selkirk (1981) argued that such an unsyllabified or stray consonant was added to an onset in one group of dialects, e.g., /giltla/ → [gi.li.ti.la] ‘I told her,’ and to the rhyme in another group, e.g., /giltla/ → [gil.ti.la]. Similarly, in Broselow’s (1992) classification, one group consisted of onset dialects and a second group were the rhyme dialects. More recently, Kiparsky (2003) indicated that the syllabification patterns of Arabic showed three groups: VC group, CV group, and C group.

While VC dialects split CCC by inserting a vowel to the left of the unsyllabified consonant, CV dialects insert a vowel to the right. C dialects keep a CCC cluster intact as the unsyllabified consonant attaches to the prosodic word with no need for vowel insertion. The simple characterization of a C dialect is its tolerance for CCC clusters word-medially. In this regard, Najdi dialects, including SNA, are C dialects. While SNA appears to be best classified as a C dialect, its epenthesis patterns present an important contribution to phonological theory and Arabic syllable structure, because SNA is not always motivated by maximum syllable weight requirements and sometimes produces opaque structures.

Generally, there is agreement that the syllable in Arabic dialects is divided into two broad types: light and heavy (Al-Ani, 1970; Brame, 1970; Broselow, 1979; McCarthy, 1979b; Selkirk, 1982). While a light syllable is composed of a singleton nucleus (a vowel) preceded by a singleton consonant onset, heavy syllables have a branching rhyme with either a nucleus composed of two vowels (long vowels) or a branching rhyme with an additional consonant as a coda. In contrast, Abboud (1979), Ingham (1994), and Alezetes (2007) reported that syllables could fall into one of three groups: light, heavy, or superheavy. Light syllables can be CV or CCV; heavy syllables can be CVC, CVV, CCVC, or CCVV; and superheavy syllables can be CVVC, CVCC, CCVVC, or CCVCC. In this distribution, onsets are obligatory while codas are optional. This turns out to be a universal pattern. Al-Qahtani (2014) summarized the distribution of syllable types with their respective positions, as reproduced in Table 3.

The distribution in Table 3 almost matches the syllable distribution of SNA except for a few syllable types. First, this dissertation shows that both superheavy syllable types (CVCC and CVCC) are not restricted to final position, as they may also appear in word-initial and medial position. Second, superheavy syllables in SNA can be CVVG, where G is the first half of a

geminate. One could argue that CVVG could be a variant of CVVC syllables. However, the data for SNA show that CVVG can also surface with a contained geminate in final and non-final position, e.g., *ra:dd* ‘returning/replying’ and *ra:dd.lih* ‘returning to him.’

Table 3

Najdi Arabic Syllable Shapes (Al-Qahtani, 2014, p. 117)

Syllable Type	Initial	Medial	Final
CV	[gi .tal] ‘he killed’	[yis. ti .ʃir] ‘he consults’	[zir. na] ‘we visited’
CVC	[ʃar .ba:n] ‘he was drunk’	[ʃaa. fat .hum] ‘she saw them’	[‘ki.tab] ‘he wrote’
CVV	[ha :.dʒim] ‘he attacked’	[mis. ta :.dʒir] ‘a tenant’	-
CVVC	[ʃa :f.hum] ‘he saw them’	[mi. ga :s.hum] ‘their size’	[yix. ta :r] ‘he selects’
CVCC	-	-	[wif. gilt] ‘what did you say?’
CCV	[k ti.bat] ‘she wrote’	-	-
CCVC	[t kal.lim] ‘you (m) are talking to’	-	-
CCVV	[z ba:.lah] ‘trash’	-	-

This study demonstrates that different types of superheavy structures could arise in different contexts. Such observations are crucial for a deeper understanding of Arabic phonology because they shed light on the definition of the syllable and draw a clearer distinction between syllabic and non-syllabic elements, distinctions made throughout this dissertation.

1.3.2 Common Vowel Processes in Bedouin Dialects

In several Bedouin dialects, there is a set of processes associated with short vowels, such as vowel raising in open syllables, trisyllabic elision, and high vowel deletion. The rules that delete short vowels are sometimes referred to as syncope. Most works on Bedouin dialects have described these processes as separate rules that operate independently, e.g., in Bedouin Hijazi Arabic (Al-Mozainy, 1981), Najdi Arabic (Abboud, 1964, 1979; Al-Solami, 2020; Al-Sweel,

1981; Al-Qahtani, 2014; Ingham, 1994), Bedouin dialects of Arabia (Ingham, 1982; 1994; Prochazka, 1988), and Bani Hassan (Irshied, 1984). One of the aims of this dissertation will be to gain a unified understanding of these processes. The following section gives a background on five common vowel processes in Bedouin dialects: vowel raising, trisyllabic elision, high vowel deletion, feminine suffix vowel deletion, and guttural metathesis.

1.3.2.1 Vowel Processes

1.3.2.1.1 Vowel Raising

In Bedouin Arabic dialects, including Najdi, a vowel raising rule raises the low vowel /a/ to /i/ or /u/ in an open syllable in non-final position, as shown in (2).

(2)	a. /katab/	[kitab]	‘he wrote’
	b. /masak/	[misak]	‘he caught’
	c. /nakad/	[nikad]	‘distress’
	d. /gatal/	[gital]	‘he killed’
	e. /madrasah/	[madrisah]	‘a school’
	f. /madaḥ/	[midah]	‘he praised’
	g. /samak/	[simak]	‘fish’
	h. /saga/	[siga]	‘he waters’

Low vowel raising occurs in all positions except word-finally, with some exceptions. The first group of segments that blocks this rule are coronal sonorants [n, l, r] when they follow a low vowel, such as *sarag* ‘he stole,’ *walad* ‘a boy,’ and *banat* ‘she built.’ The second group of segments that blocks the rule are non-emphatic gutturals (uvular /χ, ʁ/, pharyngeal /ħ, ʕ/, and laryngeal /h/) whenever they precede or follow a low vowel, e.g., *ḥaḏaf* ‘he threw’ but not **hiḏaf*, *daχal* ‘he entered’ but not **diχal*.

Many Arabic dialects have been reported to show this raising rule, such as Bedouin Hijazi (Al-Mozainy, 1981), Najdi Arabic (Abboud, 1964, 1979; Al-Sweel, 1981; Al-Qahtani, 2014; Ingham, 1994), Bedouin dialects of Arabia (Ingham, 1982; Prochazka, 1988), and Bani Hassan (Irshied, 1984).

1.3.2.1.2 Trisyllabic Elision

Another common process in most Bedouin dialects is trisyllabic elision. The term was first used to describe Jordanian Arabic by Irshied (1984) since it always occurs in trisyllabic words; i.e., disyllabic stems when they are attached with vowel initial suffix. Trisyllabic elision targets a low vowel whenever it occurs in an open syllable followed by another open syllable, as shown in (3).

(3)	a. /rasam-t/	[ri.samt]	‘I drew’
	b. /warag/	[wa.rag]	‘paper’
	c. /laga/	[li.ga]	‘he found’
	d. /katab-at/	[kti.bat]	‘she wrote’
	e. /ʔankatab-at/	[ʔank.ti.bat]	‘it (f) was written’
	f. /warag-ah/	[wri.gah]	‘a paper’

The examples show that a low vowel is deleted whenever it is followed by another low vowel, as in (3d-f). This syncope may be applicable word initially as in (3d) or word medially as in (3e) but never occurs if followed by a final low vowel, as in (3c). Arguably, trisyllabic elision applies to reduce the number of open syllables. Others have reported the same phenomenon in dialects in the Arabian Peninsula, such as Bedouin Hijazi (Al-Mozainy, 1981) and Najdi Arabic (Abboud, 1964, 1979; Al-Sweel, 1981; Al-Qahtani, 2014; Ingham, 1994). This rule was summarized by Al-Mozainy (1981) as follows: $a \rightarrow \emptyset / _ _ Ca\sigma$ (p. 62).

The rule specifies which vowel gets deleted, which is the first of two CVCV syllables: CVCV > CCV. Cross-linguistically, it is common for syncope to occur in sequences of open syllables (Taylor, 1994), referred to as the double open syllable environment by Goldsmith (1990) and the two-sided open syllable environment by McCarthy (1986).

1.3.2.1.3 High Vowel Deletion

Another syncope rule that targets short vowels is high vowel deletion, which deletes high vowels in open non-final syllables, as shown in (4).

(4)	a. /ka:tibah/	→	[ka:t.bah]	‘a writer (f)’
	b. /kila:b/	→	[kla:b]	‘dogs’
	c. /ħiba:l/	→	[ħba:l]	‘ropes’
	d. /sa:kiti:n/	→	[sa:k.ti:n]	‘they are silent’
	e. /gulu:b	→	[glu:b]	‘hearts’
	f. /ku.'ru:t/	→	[kru:t]	‘cards’
	g. /gu.bu:r/	→	[gbu:r]	‘graves’
	h. /fu.nu:n/	→	[fnu:n]	‘arts’
	i. /hi.'za:m/	→	[ħza:m]	‘belt’
	j. /nu.ʕu:l/	→	[nʕu:l]	‘shoes’
	k. /χu.fu:m/	→	[χfu:m]	‘noses’
	l. /tu.ra:b/	→	[tra:b]	‘sand’

As the data show, high vowel deletion gives rise to consonant clusters word-initially and medially. This process has been reported in Najdi Arabic (Abboud, 1964, 1979; Al-Qahtani, 2014; Ingham, 1994) and many other Bedouin dialects, such as Bedouin Hijazi Arabic (Al-Mozainy, 1981; Al-Solami, 2007) and Ruwaili Arabic (Al-Solami, 2020).

1.3.2.1.4 Feminine Suffix Vowel Deletion

Yet another vowel syncope process pertains to the low vowel in the feminine suffix *-at* in certain environments, as shown in (5).

(5)	a. /fa:f-at-ih/	[fa:f.tih]	‘she saw it’
	b. /ga:l-at-ih/	[ga:l.tih]	‘she said it’
	c. /mo:t-at-ih/	[mo:t.tih]	‘his death’
	d. /lo:ħ-at-i/	[lo:ħ.ti]	‘my painting’
	e. /madrās-at-ih/	[mad.ris.tih]	‘his school’
	f. /maktab-at-ih/	[mak.tib.tih]	‘his library’
	g. /warag-at-ih/	[wrig.tih]	‘his paper’
	h. /ʔadʒar-at-ih /	[ʔdʒirt.ih]	‘his tree’

This behavior was first noted by Al-Mozainy (1981) in Bedouin Hijazi Arabic, described by the following rule: 3.f.s. → vowel deletion: V → Ø / ____ tV [+Suffix] (p. 258). Note that the

rule states that the syncope applies to the vowel before the segment [t] only if it is a suffix and not part of the root. Also note that in nominal and adjectival forms, the suffix *-at* alternates /ah~at/ depending on its position. It surfaces as /ah/ only if it occurs word-finally, e.g., *mad.ri.sah* ‘school’ vs. *mad.ri.sat.ha* ‘her school.’ Regardless of this alternation, the syncope always pertains to the form *-at* since it is the only variant that occurs word-internally.

1.3.2.2 CV Metathesis

In addition to vowel processes, Arabic dialects exhibit a CV metathesis process that involves both vowels and consonants. CV metathesis is a phonological process whereby the underlying linear order of two adjacent segments is switched, as in CV > VC or VC > CV. In Najdi and other Bedouin Arabic dialects, whenever there is a guttural fricative (uvular /χ, ʁ/, pharyngeal /ħ, ʕ/, and laryngeal /h/) followed by the low vowel /a/, these segments switch their linear order on the surface, which may appear to be CV metathesis, as shown in (6).

- | | | | |
|-----|--------------|------------|------------|
| (6) | a. /taχrab/ | [tχa.rab] | ‘go bad’ |
| | b. /naħsib/ | [nħa.sib] | ‘we count’ |
| | c. /gahwah/ | [għa.wah] | ‘coffee’ |
| | d. /maʕru:f/ | [mʕa.ru:f] | ‘known’ |
| | e. /maχsu:l/ | [mχa.su:l] | ‘washed’ |

This is known in the literature as guttural metathesis and usually results in initial complex consonant clusters. What the dataset shows is that guttural consonants, including /χ, ʁ, ħ, ʕ, h/, are not tolerated in the coda in non-final syllables. However, this sound change is restricted to one complex environment, namely whenever a guttural appears in a preconsonantal position and is preceded by a vowel. If one of these two conditioning factors is missing, no change occurs. Thus, whenever there is a low vowel preceding a guttural, but no consonant follows, no metathesis takes place, as shown in (7).

- (7)
- | | | |
|---------------|------------------------------|------------------|
| a. /wad̥ʒaʕ/ | →[wid̥ʒaʕ]/*[wid̥ʒʕa] | ‘illness |
| b. /wasʕaχ/ | →[wisʕaχ]/*[wisʕa] | ‘dirt’ |
| c. /saħab/ | →[saħab]/*[šħab]/*[šħaab] | ‘he pulled’ |
| d. /taḵaddaw/ | →[taḵaddaw]/*[tḵadda] | ‘they had lunch’ |
| e. /ðʕahar/ | →[ðʕahar]/*[ðʕhar]/*[ðʕhaar] | ‘he appeared’ |

Likewise, metathesis does not apply if a preconsonantal guttural is preceded by vowels other than the low short vowel /a/, as shown in (8).

- (8)
- | | | |
|---------------|-------------|----------------|
| a. /tuxmah / | →[tuxmah] | ‘satiety’ |
| b. /d̥ʒuʕmah/ | →[d̥ʒuʕmah] | ‘a sip’ |
| c. /suħbah/ | →[suħbah] | ‘friendship’ |
| d. /sʕuʕlu:k/ | →[sʕuʕlu:k] | ‘a ragamuffin’ |
| e. /muhrah/ | →[muhrah] | ‘filly’ |
| f. /mixlab / | →[mixlab] | ‘claw’ |
| g. /miḵrafah/ | →[miḵrafah] | ‘ladle’ |
| h. /wiħdah / | →[wiħdah] | ‘loneliness’ |
| i. /ʕiʕlah/ | →[ʕiʕlah] | ‘a flame’ |
| j. /sihmah/ | →[sihmah] | ‘a share’ |

Most works on Najdi and other Bedouin dialects have reported this phenomenon as a case of synchronic metathesis (e.g., Al-Mozainy, 1981; Al-Solami, 2013; Al-Qahtani, 2014; Ingham, 1994; Zawaydeh, 1999). Others such as Abboud (1979) and Blevins and Garrett (2004) have pointed out that guttural metathesis may actually be a two-stage process: post-guttural epenthesis followed by a deletion process. This dissertation sheds light on these arguments, and will present arguments in favor of the two-stage analysis.

1.4 OT Framework

OT states that phonological processes are not governed by rules but rather by a set of violable and universal constraints (McCarthy & Prince, 1993a, 1993b; Prince & Smolensky, 1993, 2004). Within OT, there are three basic components, GEN (“generator”) and CON (“constraints”), and EVAL (“evaluator”). GEN is responsible for generating an infinite number of output candidates for a given underlying form, CON is a set of ranked constraints, and EVAL is a procedure for evaluating output candidates based on the constraint ranking. The constraints

fall into two types: markedness constraints, which regulate the well-formedness of the output forms, and faithfulness constraints, which require the surface forms be faithful to their corresponding input forms.

We can use syllable structure to provide basic examples of markedness constraints.

Prince and Smolensky (1993, 2004) showed that the basic syllable inventory can be accounted for by two markedness constraints, as demonstrated in (9).

- (9) Markedness Constraints
- a. ONS: Syllables must begin with onsets.
 - b. *COD (also known as NO-CODA constraint): Syllables should not contain codas.

These constraints state that a syllable without an onset violates ONS, and a syllable with a coda violates COD. Deriving the desired output requires an interaction between markedness constraints and a set of faithfulness constraints. The two basic faithfulness constraints were proposed by Prince and Smolensky (2004), as shown in (10).

- (10) Faithfulness Constraints
- a. MAX-IO: Each input segment has a corresponding output segment (no deletion).
 - b. DEP-IO: Each input segment has a corresponding output segment (no epenthesis).

Each of these constraints requires each surface form to be faithful to the underlying form. While the MAX-IO resists any deletion to surface forms, DEP-IO ensures that no additional segment is inserted. These basic constraints are provided as examples; in the phonological literature as well as in this dissertation, many other markedness and faithfulness constraints are used.

In an OT analysis, the constraints are ranked in a certain order. The less important constraints are ranked lower and may be violated to ensure satisfaction of higher-ranked constraints. Individual constraints are universal, while their ranking is language-specific; thus, languages differ depending on this ranking. In other words, each language has the same finite set

of constraints, and apart from the morphology and lexical input, the phonological distinctions seen cross-linguistically are attributed to the different rankings of these constraints.

OT has become a widely-used framework for analyzing syllable properties and structures (McCarthy & Prince, 1993a, 1993b; Prince & Smolensky, 1993, 2004), and this dissertation adopts OT to analyze the SNA data. One advantage is its ability to offer a uniform analysis for syllable structures of SNA and other Arabic dialects through a set of universal constraints. In this respect, dialect differences on the surface are attributed to their individual ranking of these constraints. Another advantage of OT is the manner in which it deals with the conspiracy problem in phonology. In phonology, the conspiracy problem is when several processes are said to work together to ensure that certain surface structures do not arise (Kisseberth, 1970). For instance, one syncope process in SNA applies to the vowel of the feminine suffix if it occurs in an open syllable. However, if the output results in a complex cluster, the process is blocked. OT, an output-oriented model, can better handle these situations, given that each violable constraint can be dominated by higher or inviolable constraints. By adopting a constraint-based model, this dissertation offers a more thorough analysis of the syllable structures and related phenomena in SNA.

1.5 Opacity and OT

One of the problems addressed in this dissertation are non-surface true forms in SNA. In SNA, sometimes a given process seems to overapply or underapply on the surface when other processes interact. This is demonstrated in (11) and (12).

The examples in (11) show an interaction between three processes: trisyllabic elision, vowel raising, and feminine suffix vowel deletion. The surface forms show an overapplication of

vowel raising given that the raised vowel occurs in a closed syllable, while vowel raising typically applies to vowels in open syllables.

- (11) a. /katab-at-ih/ [ktib.tih] ‘she wrote it’
 b. /maktab-at-ih/ [mak.tib.tih] ‘his library’
 c. /warag-at-i/ [wrig.ti] ‘my paper’
- (12) a. /kasr/ [kasir] ‘breaking’
 b. /ʃakl/ [ʃakil] ‘shape’
 c. /nadʒm/ [na.dʒim] ‘star’

The opposite is true in (12), where vowel raising underapplies when it interacts with epenthesis due to SSP, a process explained in Chapter 6. If vowel raising transparently applied to these surface forms, we would expect forms like *[kisir]. These forms show what is known in the literature as opacity. The term “opacity” here refers to a phenomenon where surface forms do not match generalizations in the language (Kager, 1999b, p. 372). According to Kiparsky (1971, 1973), a phonological rule that is non-surface true due to the application of a subsequent phonological rule is said to be opaque. Building on Kiparsky (1973), McCarthy (2003) provided a description of opacity as a rule in (13).

- (13) Opacity: a phonological rule P of the form A => B/C ----- D is said to be opaque if one of two surface forms arises:
 a. Forms of A in the environments C ----- D.
 b. Forms of B derived by P that takes place in environments other than C ----- D. (p. 44)

In a rule-based phonology, opacity can be explained by rule ordering. Thus, surface forms in (11) and (12) are said to undergo vowel raising first, followed by suffix vowel deletion and epenthesis, as in (14).

(14)	Underlying representation	/katab-at-ih/	/kasr/
	Trisyllabic elision	ktabatih	_____
	Vowel raising	ktibitih	_____
	Feminine suffix vowel deletion	ktib.tih	_____
	SSP epenthesis	_____	kasir
	Surface representation	[ktib.tih]	[kasir]

The opacity is recognized by stipulating that vowel raising occurs earlier in the derivation. In the form [ktib.tih], vowel raising and feminine suffix vowel deletion are in a counterbleeding relationship because deletion is applied too late to prevent the vowel raising rule. By contrast, the form [kasir] shows that vowel raising and epenthesis are in a counterfeeding order because epenthesis occurs too late to set up the context for vowel raising.

Opacity, however, poses a problem for classical OT, because the theory does not provide for any intermediate stages in a derivation. Instead, output forms are produced in a single mapping from the input. Nonetheless, several works in the literature have attempted to account for opacity from an OT perspective. One of the earliest was the PARSE/FILL theory proposed by Prince and Smolensky (1991, 1993). Under this analysis, all properties of a given input must be encoded into the output regardless of the surface shape. Thus, a deleted segment is actually present in the output but simply not parsed to a syllable. By the same logic, an inserted segment is not present in the output, though its syllabic position is. Two constraints militate against this type of faithfulness: PARSE, which militates against underlying segments that are not parsed on the surface (i.e., deleted), and FILL, which militates against empty structures so epenthesis is enforced. A problem with the PARSE/FILL theory is its shortcoming in some opaque cases where intermediate stages appear necessary (McCarthy, 1999, p. 5).

Another OT model has proposed output-output and base-output correspondence relations as a way to deal with opacity (Adra, 1999; Benua, 1997; Kager, 1999b; Kenstowicz, 1996; Steriade, 1997). The output-output correspondence approach assumes opaque structures transpire to achieve paradigm uniformity among morphologically related surface forms. This is stipulated by means of faithfulness constraints and designating one surface form called the “base” as the reference to all other surface forms within its paradigm. Under this account, it is assumed that

when some opaque structure arises, there is potentially one related form that surfaces transparently. This form serves as the base for the paradigm, and all other forms that belong to the same paradigm, including opaque, must be faithful to the base rather than the input.

Despite the potential of an output-output approach, it fails to provide a solution for the opacity problem in many languages (Benua, 1997; Itô & Mester, 1997; Kabrah, 2004; Karvonen & Sherman, 1997; McCarthy, 1999). McCarthy (1999) noted that since output-output requires one surface form in the paradigm to serve as the base, it could explain the otherwise opaque structures within that paradigm. However, sometimes opacity found in a given form is not traceable to other related forms within its paradigms. For instance, in Maltese Arabic, a guttural triggers vowel lowering, and a guttural is deleted if it occurs word-finally. When these two processes interact, the forms that surface with a final low vowel are difficult to account for, as illustrated in (15).

- (15) a. Pre-guttural vowel lowering: $V \rightarrow a / \text{Guttural}$
 e.g. *nimsiħ* → *nimsaħ* ‘I wipe’
 b. Final guttural deletion: $\text{Guttural} \rightarrow \emptyset / _ \#$
 Interaction: */nismiħ/* → */nismaħ/* → [nisma] ‘I hear’ (McCarthy, 1999, p. 8)

The word [nisma] shows vowel lowering with an assumed underlying deleted guttural, yet no other surface forms are observed with a guttural. Another issue with output-output OT models is that, in some cases, using base forms to explain other opaque structures would leave other forms within the paradigm unexplained. For example, in addition to the vowel raising of low vowels in open non-final syllables, SNA shows low vowel deletion of the feminine suffix -at in an open syllable, as illustrated in (16).

- (16) a. /katabat-ih/ [ktibtih] ‘she wrote it/him’
 b. /ʃarafat-ih/ [ʃriftih] ‘she knew it/him’
 c. /waragat-ih/ [wrigtih] ‘his paper’
 d. /maragat-i/ [mrigti] ‘my broth’

Based on an output-output approach, words like in (16) must have other morphologically related forms as bases. Thus, the overapplication of reduction or raising in a closed syllable in [ktibtih] can be explained by assuming that the form is faithful to another base form, [ktibat] ‘she wrote.’ Nonetheless, other surface forms where reduction does not overapply such as [kitabtih] ‘I wrote it’ cannot be explained with this conception of output-output faithfulness. Instead, the dataset indicates the surface form [katabat-ih] shows a serial derivation of /katabatih/ > /kitibitih/ > [ktibtih], so vowel raising or reduction applies first, followed by deleting the feminine suffix vowel. This is problematic for an output-output approach, which is why an input-output dichotomy must be established.

The shortcomings of input-output and output-output correspondence theories led researchers to propose intermediate forms and rule-based derivations. For example, in Sympathy Theory, McCarthy (1999, 2003) suggested that opaque output candidates should not be evaluated based on faithfulness to the input but rather based on faithfulness to one failed candidate called the ‘sympathetic candidate.’ This failed candidate is the most harmonic form among a set of potential candidates which obeys a designated input-output (IO) faithfulness constraint. This designated constraint, ‘the selector’, is violated by all competitor candidates except one, the failed candidate, and the competitors are mapped in terms of similarity to this candidate.

While Sympathy Theory brings an insightful premise to opacity in SNA, it also comes with limitations. For instance, in cases where vowel raising fails, e.g., /badw/ > [badu] but not [*bidu], a failed (sympathetic) candidate [baduw] could be proposed based on the MAX-IO constraint. For opaque stress, on the other hand, one could assume [‘miθilhum] ‘like them’ with opaque initial stress due to epenthesis is the actual output since it is more faithful to the sympathetic [miθilhum] (also the underlying representation) than a transparent [mi’θilhum],

where stress is on the heavy syllable. The sympathetic candidate would be based on a faithfulness constraint, such as IDENT-STRESS (Pater, 2000, p. 252), which militates against changing the stress of the input. However, when dealing with multiple opacity forms where both stress and vowel raising are present (as examined in Chapter 6), the model explanation for sympathy relation becomes more complicated. According to McCarthy (1999, 2003), a language could have more than one sympathy relation simultaneously. This possibility makes it possible to deal with different phenomena in different forms, but when dealing with simultaneous opaque vowel raising and opaque stress, it becomes less clear which faithfulness constraint is designated as a selector.

Others argue that opacity that it is merely a byproduct of the morphological processes that take place during the construction of a word from the stem level to outermost strata, and the phonological processes that apply at each stratum. Within this view, lexical phonology-morphology interactions should be taking place at different strata (Kiparsky, 1971, 2003), an approach that does allow for intermediate forms. Within this approach, however, opacity is generated at the post-lexical level only, where certain processes crucially no longer apply. In my analysis of the data for SNA, I adopt Kiparsky's (1971, 2003) model that opacity must be attributed to different levels of phonology. The sections below describe the basics of lexical phonology and how they can be implemented in OT.

1.6 Lexical Phonology and Stratal OT

1.6.1 Lexical Phonology

Several frameworks have attributed opaque structures to interactions between phonology and morphology. As noted above, one such model is lexical phonology (Booij, 1995; Booij & Rubach, 1987; Kaisse & Shaw, 1985; Kiparsky, 1973, 1982, 1985, 2000, 2003; Mascar, 1976;

Mohanan, 1982; Rubach, 2008), which suggests that different components of grammar must interact at different levels. Booij (1997) defined lexical phonology as a theory built on two core hypotheses, as shown in (17).

- (17) Lexical Phonology Core Hypotheses
a. “There is a systematic difference between lexical and postlexical phonology.”
b. “Morphology and phonology apply in tandem.” (Booij, 1997, p. 262)

These hypotheses carry two assumptions. The first is the presence of distinct phonologies: lexical phonology, which interacts with the morphological components, and post-lexical phonology, which applies when access to morphological information is no longer available. For example, in English, trisyllabic vowel shortening is considered a lexical process, e.g., the first vowel in [sem] ‘sane’ alternates to a different vowel when a suffix is added to the word, [sænɪri] ‘sanity.’ In contrast, flapping, a process that applies to alveolar stops /t, d/, is said to be a post-lexical process since it can be applied across word boundaries, e.g., [wʌt ə deɪ] ‘what a day.’

The second assumption is that morphology and phonology processes apply in a cyclic fashion, applying once when an affix is attached to a root, applying again when another affix is attached to that stem, and so on. Thus, it is conceivable that morphological processes, such as affixation, give rise to new domains for phonological processes. Kiparsky’s (2000) analysis of Levantine Arabic pointed out a distinction between two lexical layers (p. 358). First is the inner layer, which involves the stem with the closest affixes, e.g., subject agreement and applicative affixes. Second is the outer layer, which usually involves word-level affixation, such as object agreement or nominal affixes (e.g., possessive suffixes).

Following Kiparsky’s (2000) model, I propose that phonological processes apply at different morphological strata in SNA. Thus, the assumption is that each morphological level

will interact with one level of phonology. First, there is lexical phonology, which is realized at two morphological levels, the stem and the word. The stem level includes the stem and the stem plus the subject affixes, whereas the word level involves the stage where object and possessive suffixes are attached. Similar proposals have been suggested for different Arabic dialects (e.g., Meccan Arabic (Kabrah, 2004); Ma’ani Arabic (Rakhieh, 2009), San’ani Arabic (Watson, 2002) and most recently in Ruwaili Arabic (Al-Solami, 2020).

Table 4 shows that different affixes are attached at different levels of morphology and therefore are expected to give rise to different phenomena. For instance, trisyllabic elision is only applicable at the word level, so whenever vowel raising and trisyllabic elision interact, trisyllabic elision is expected to apply first since it is also found at the stem level. This is explained in greater depth in the following chapters.

Table 4

Affixation at Different Levels of Morphology

Morphology	Affixes	Lexical Phonology
Stem 1, 2	Subject affixes Applicative affixes	Vowel raising High vowel deletion Stress Post-guttural epenthesis
Word level	Object suffixes Possessive suffixes Dative suffixes	Vowel raising High vowel deletion Stress Trisyllabic elision Feminine suffix vowel deletion
		Post-Lexical Phonology
		SSP epenthesis Complex margin epenthesis

1.6.2 Stratal OT

Stratal OT implements the assumptions of lexical phonology within a constraint-based framework. It proposes that opacity arises due to morphology-phonology interactions at three

levels or strata: the stem, the word, and the phrase or post-lexical level. Each level is associated with its own constraint ranking, with the output of one level serving as the input to the next, such that a serial derivation is accomplished (Bermudez-Otero, 2003, 2006; Idsardi, 1997; Kiparsky, 1993 2000, 2003, 2015; Roca, 1997; Rubach, 1997). Kiparsky (2015) defined the model by its capability to incorporate two common principles in linguistics, as shown in (18).

- (18) a. “Modularity: Grammar is organized into components that interface via their input and output representations.”
b. “Optimality Theory: Grammars are constituted by systems of ranked violable constraints.” (Kiparsky, 2015, p. 4)

Unlike serial models of lexical phonology, in Stratal OT, each level or stratum “constitutes a distinct parallel constraint system” (Kiparsky, 2015, p. 3). Thus, the interaction of faithfulness and markedness constraints at each level determines the properties of input that are retained in the output. This modeling is summarized in (19).

- (19) a. “Stratification: phonology and morphology are organized into STRATA (also known as LEVELS), each constituting a parallel constraint system.”
b. “Level-ordering: each of the cross-categorial domains stem, word, phrase corresponds to a morphosyntactic and phonological stratum.”
c. “Cyclicity: Stems and words must satisfy the applicable stem and word constraints at every stage.” (Kiparsky, 2015, p. 4)

As per (19), it is possible to have a certain ranking for a set of constraints at one level and another ranking for the same set at a different level, although the addition of more constraints is always applicable. This flexibility of reranking constraints at different levels reveals why certain forms are not surface true, i.e., why they show opacity. This study has adopted a Stratal OT model, particularly in cases where multiple phonological phenomena are concerned, and opaque structures may arise. However, when parallel OT can handle the data, I use it instead of Stratal OT for the sake of brevity.

1.7 Overview of the Dissertation

This study investigates phonological and morphological phenomena in SNA that have received little attention. As such, one of the goals was to shed light on these issues and close the gap in previous descriptions, particularly the representation of superheavy syllables and certain cases of opacity. The remaining of this dissertation is orderly organized as follows. Chapter 2 analyzes the unique syllable structures in SNA. It presents the theory of the syllable and mora and evaluates previous approaches to superheavy syllables in dialectal Arabic phonology. It then addresses questions about why superheavy syllables are avoided in this dialect.

Chapter 3 explores three common vowel processes in SNA: vowel raising, high vowel deletion, and feminine suffix vowel deletion. Though these processes are not unique to the dialect, their interaction can lead to opacity. I illustrate the basics of syllable structure and vowel processes in Arabic dialects and highlight shortcomings in previous analyses in light of SNA. Using a Stratal OT framework, I argue that the problem of opacity cannot be solved unless different morphological levels are assumed for each phonological process.

Chapter 4 sheds light on another segmental process, guttural metathesis. The chapter explores some of the limitations of previous analyses of this phenomenon. In doing so, it seeks to provide a better analysis, showing that guttural metathesis is a two-stage process.

Chapter 5 examines stress assignment, a suprasegmental phenomenon in SNA. Although the dialect behaves like most Arabic dialects with regard to stress assignment, it shows a preference for trimoraic rather than bimoraic foot parsing.

Chapter 6 explores additional types of opacity in SNA, including segmental processes such as epenthesis and vowel raising as well as suprasegmental processes such as stress. The

chapter shows the need for a post-lexical phonology in SNA represented by Stratal OT. Finally, Chapter 7 concludes the overall analysis with implications and suggestions for future studies.

Chapter 2: The Representation of Superheavy Syllables in SNA

2.1 Introduction

This chapter provides a unified account of the representation of so-called superheavy syllables in SNA. Before investigating the structures of superheavy syllables, the chapter defines the nature of a syllable in general and how syllable weight is measured. In this dissertation, I often refer to syllables in terms of weight which is based on moraic theory (Hayes, 1989; Hyman, 1985; McCarthy & Prince, 1986). After discussing foundational syllable concepts, I present syllable structures in Bedouin dialects with a focus on Najdi dialects. Next, I present syllable patterns that are unique to SNA. This is followed by an overview of major approaches to superheavy syllables, especially peripheral consonants: the semisyllable, mora-sharing, and the trimoraic approaches. I evaluate each to see which model best fits the SNA data. Lastly, I discuss how SNA syllable patterns can be implemented in an OT model.

2.1.1 The Syllable

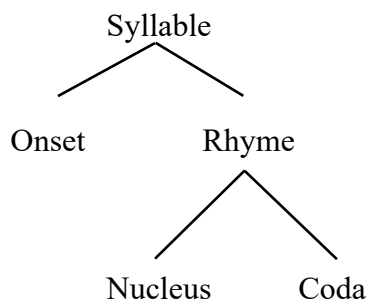
In traditional phonology, the stance on the syllable as a constituent has been conservative, with some considering the concept unnecessary (e.g., Kohler, 1966, p. 207). The syllable was also absent from Chomsky and Halle's (1968) generative phonology. It did not take long, however, for phonologists to see the necessity for syllables to explain some cross-linguistic phenomena (Fudge, 1969; Hooper, 1972; Johnstone, 1967a, 1967b; Vennemann, 1972). Kahn (1976), Broselow (1979), Clements and Keyser (1983), McCarthy (1979a, 1979b), Selkirk (1982), and Blevins (1995) developed the structure of the syllable in phonology theory. They offered three pieces of evidence supporting the phonological role of a syllable. The first was the existence of phonotactic patterns across languages. For example, the string of sounds /ɪn/ is not allowed to begin a word in English but can appear in word-medial position, as in *burner*. Such

patterns cannot be explained outside the domain of syllables (Kahn, 1976). Second, several segmental phonological processes appear to be conditioned by syllable boundaries (Blevins, 1995). For instance, nasalization, compensatory lengthening, and palatalization have been reported to apply only within syllables (Broselow, 1979). Third, syllables appear to form an entity in suprasegmental phenomena. For instance, stress and tone rules cannot be explained by segmental, word, or morpheme levels, suggesting an intermediate tier (the syllable) to account for these phenomena.

The internal structure of a syllable consists of two constituents, the onset and the rhyme. The onset is a consonant or multiple consonants if clusters are allowed (Clements, 1990; Davis, 1988; Selkirk, 1982; Halle & Vergnaud, 1980), while the rhyme is composed of a nucleus and coda. The nucleus or peak of the syllable is the vocalic part, and the coda consists of any consonants at the right edge of the syllable. This structure is shown in Figure 3.

Figure 3

Syllable Structure



A crucial property of syllables is their so-called weight. The heaviness of a syllable is typically measured using the mora, as explained in moraic theory.

2.1.2 Moraic Theory

Moraic theory was introduced by Hyman (1985) and McCarthy and Prince (1986) and developed by Hayes (1989) and Broselow (1995). This approach produced the concept of the

mora, a measurement unit which made it possible to distinguish between lighter and heavier syllables. While light syllables are monomoraic (containing one mora), heavy syllables are considered bimoraic (containing two moras). These types of syllables are illustrated in Figures 4 and 5, respectively, taken from Hayes (1989, p. 258).

Figure 4

Light Syllables

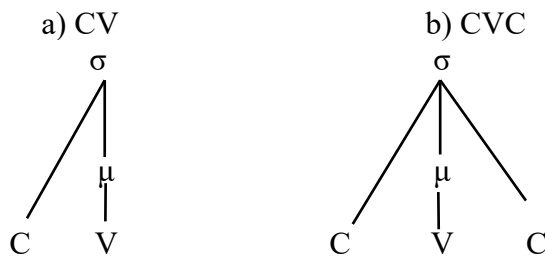
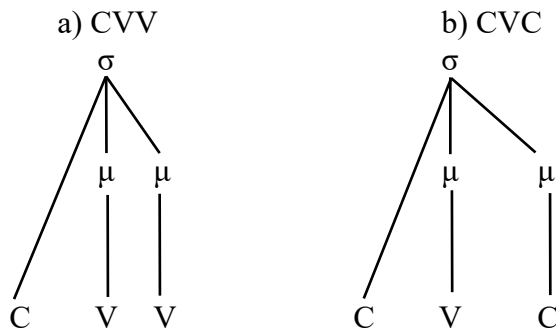


Figure 5

Heavy Syllables



Generally, moras are restricted to the rhyme of a syllable, as onsets do not add to the weight and therefore are not assigned any mora.² Thus, a short vowel is represented by one mora and a long vowel by two. Coda consonants may or may not be moraic. For instance, CVC is considered a light syllable unless the coda acquires a mora depending on its position. This is

² Many languages have been described with moraic onsets, e.g., Pirahã (Arabela), Karo, Aranda, Truckese, Pattani Malay, Marshallese, and Bellonese. See Topintzi (2006); Rakhieh (2009) for further discussion on this matter.

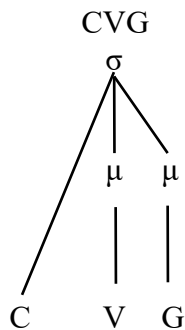
dictated by a constraint called Weight-By-Position (WBP), which is operative in some languages but not others, as stated in (1). When this constraint has applied, all CVV and CVC syllables have the same weight, given that each type is bimoraic.

(1). Weight-By-Position (WBP): a coda consonant is represented with a mora (Hayes, 1989).

This description outlines what is known as the core syllable (Clements & Keyser, 1983). Another common syllable type is CVG, where G is the first part of a geminate, though the status of geminates is less clear. While some scholars state they occupy two C slots and acquire their moraicity by position like other codas, others assert geminates are inherently moraic (Davis, 1994; Hayes, 1989). These issues are discussed in Chapter 5. Regardless of how moras are assigned, geminates can be heavy in non-final position, as outlined in Figure 6.

Figure 6

Heavy Syllables with Geminates



2.2 Superheavy Syllables

While superheavy syllables (i.e., CVCC and CVVC) are widely attested in several Arabic dialects, including Najdi Arabic, they are typically restricted to appear in word-final position (Abu-Mansour, 1987; Al-Mohanna, 1998; Al-Mozainy, 1981; Bakalla, 1973; Bamakhramah, 2009; Broselow, 1980; Irshied, 1984; Itô, 1989; Kiparsky, 2003; McCarthy, 1981; Watson,

2007). This suggests there is a restriction against superheavy syllables in word-internal position; when these are present in underlying representations, a repair strategy is necessary.

A common repair strategy to avoid word-internal superheavy syllables is vowel epenthesis. In Urban Hijazi Arabic, for instance, Al-Mohanna (1998) reported that syncope may give rise to superheavy CVVC syllables in non-final position. However, CVCC syllables were not tolerated, and a vowel has to be inserted to resyllabify the final consonant of the clusters, e.g., CVCC > CVC.Cv. In Najdi Arabic, Al-Qahtani (2014) reported a similar pattern, where only CVVC was tolerated. When affixation leads to three consonants, however, vowel insertion occurs. As a result, a structure like CVCC_CV would surface as CVCCvCV. This epenthesis is motivated by the requirement to avoid medial CVCC syllables in Najdi Arabic (Alhammad, 2018; Al-Qahtani, 2014; Ingham, 1994; Kiparsky, 2003) as in (2), and to avoid CVVC in Northern Najdi Arabic (Al-Solami, 2020), as in (3).

- (2). a. /bint-na/ → [bintina] ‘our daughter’
 b. /ʃift-hum/ → [ʃiftihum] ‘I saw them’
- (3). a. /dʒe:b-ha/ → [dʒe:baha] ‘her pocket’
 b. /dʒe:b-hum/ → [dʒe:bahum] ‘their (m) pocket’

Other dialects of Najdi allow superheavy syllables word-medially in certain contexts. In one dialect of Northern Najdi (Ruwaili), superheavy syllables of the shape CVVC and CVCC have been reported due to syncope (Al-Solami, 2020). In contrast, neither syllable shape could appear in non-final position with morphological concatenation or affixation. In affixation contexts, superheavy syllables are avoided by triggering an epenthesis when attached to a consonant-initial suffix. These observations show how dialects vary in tolerating different types of superheavy syllables and different contexts.

Another repair strategy to avoid non-final superheavy syllables is segment shortening. A common example is long vowel shortening. Though no Bedouin dialects have been reported to show this pattern, a well-documented example is Cairene Arabic. In this dialect, an underlying long vowel is shortened when a potential superheavy CVVC syllable might occur in word non-final position. For example, /saab-hum/ surfaces as [sab.hum] ‘he left them.’ A similar shortening occurs with geminates in superheavy syllables. According to Watson (2007), this process is known as partial degemination. A type of partial degemination has been reported to apply in some Yemeni dialects, such as Al-Hudaidah and San’ani, where underlying geminates surface with phonetically reduced duration whenever syncope takes place, e.g., /jitowwiruh/ > [jitowwruh] ‘they boil it’ and /jilabbis-uu/ > [jilabb.suu] ‘they (m) put on’ (Naïm-Sanbar, 1994; Watson, 1999, 2002). In sum, dialects differ in their representations of superheavy CVXC syllables (where X stands for either V or C) in final and non-final position. While most modern Arabic dialects avoid non-final superheavy CVVC and CVCC syllables through vowel epenthesis, some may tolerate CVXC syllables in non-final position.

2.2.1 Superheavy Syllables in SNA

As mentioned earlier, Arabic dialects generally show restrictions against superheavy syllables in non-final position, with some exceptions. In contrast, SNA shows a greater tolerance for non-final superheavy syllables. Superheavy syllables, represented as CVXC, can be formed by CVVC or CVCC. Furthermore, each type can arise in different contexts, such as syncope or attached suffixes. A third type, which may be subsumed under the second, are CVG syllables with tautosyllabic geminates, illustrated in (4) and (5).

(4). Superheavy Syllables Due to Syncope

CVVC Syllables

a. /ʃa:fat-ih/	[ʃa:f.tih]	‘she saw him’
b. /ga:lat-ih/	[ga:l.tih]	‘she said it’
c. /ka:tibah/	[ka:t.bah]	‘a writer (f)’
d. /ma:sik-ah/	[ma:s.kah]	‘she is holding’
e. /gi:m-at-i/	[gi:m.ti]	‘my value’
f. /no:m-at-ih	[noa:m.tih]	‘his sleep’

CVCC Syllables

a. /jaktub-u:n/	[jakt.bu:n]	‘they write’
b. /jasbug-u:n/	[jasb.gu:n]	‘they precede’
c. /tamsiku:n/	[tams.ku:n]	‘you (plural) catch’
d. /jardʒifu:n/	[jardʒ.fu:n]	‘they shiver’
e. /mindʒiz-i:n /	[mindʒ.zi:n]	‘they have accomplished’
f. /migbil-i:n/	[migb.li:n]	‘they are heading’

CVG Syllables

a. /mi-kallimih/	[mkall.mah]	‘she has talked’
b. /m-lab.bi.sah/	[mlabb.sah]	‘she has dressed’
c. /misakkirah/	[msakk.rah]	‘closed’
d. /mi-ʕallig-ah/	[mʕall.gah]	‘she is hanging up’
e. /mitʕaffir-ah/	[mtʕaff.rah]	‘broke (f)’
f. /midʒarribi-h/	[mdʒarr.bah]	‘she has tried’

(5). Superheavy Syllables Due to Affixation

CVVC Syllables

a. /ba:b-kum/	[ba:b.kum]	‘your (plural) door’
b. /dʒa:r-ha/	[dʒa:r.ha]	‘her neighbor’
c. /be:t-ha/	[be:t.ha]	‘her house’
d. /go:m-na/	[go:m.na]	‘our people’
e. /ʃa:f-hum/	[ʃa:f.hum]	‘he saw them’
f. /dʒa:b-l-ih/	[dʒa:b.lih]	‘he brought for him’

CVCC Syllables

a. /bint-kum/	[bint.kum]	‘your (plural) daughter’
b. /katabt-hum/	[kitabt.hum]	‘I wrote them’
c. /ʃift-na/	[ʃif.tna]	‘you saw us’
d. /gult-l-ih/	[gult.lih]	‘I said to him’
e. /radʒaʕt-b-ih /	[ridʒaʕt.bih]	‘I came back with it’
f. /ħaðart-l-ih/	[ħaðart.lih]	‘I attended for him’

CVG Syllables

a. /maħall-na/	[ma.ħall.na]	‘our place/store’
b. /ħaðʕðʕ-na/	[ħaðʕðʕ.na]	‘our luck’
c. /ħadd-ha/	[ħadd.ha]	‘her limit’
d. /radd.ha/	[radd.ha]	‘he returned her/it’
e. /ʃarr.hum/	[ʃarr.hum]	‘their evil’
f. /rabb.kum/	[rabb.kum]	‘your god’

CVVG Syllables

a. /ħa:dd-hum/	[ħa:dd.hum]	‘forcing them’
b. /sa:bb-na/	[sa:bb.na]	‘dispraising us’
c. /dʒa:rr-l-ih/	[dʒa:rr.lih]	‘pulling for him’
d. /ra:dd-kum/	[ra:dd.kum]	‘rejecting you’
e. /sʕa:bb-l-ih/	[sʕa:bb.lih]	‘pouring for him’
f. /fa:kk-b-ih/	[fa:kk.bih]	‘doubting him’

These examples show how superheavy syllables arise in non-final position in surface forms in SNA without the repair strategies attested in most other dialects, such as vowel epenthesis, vowel shortening, degemination, and consonant deletion. These superheavy syllables are derived by syncope, morphological concatenation, or affixation.³ When I refer to affixation in these cases, it is not to say that no affixation occurs in the syncope-induced examples. In fact, affixation must play a role in all the examples given. However, affixation is the only source for deriving superheavy syllables as in (5), compared to (4), where affixation is present, but the superheavy syllables in the surface forms are derived directly through syncope.

2.2.2 Previous Approaches to Superheavy Syllables

If CVXC syllables are attested in SNA, how are they represented? Different proposals in the literature of Arabic have been made to account for such representations. These include proposals for semisyllables, mora sharing, onset maximization, and trimoraic syllables, each of which is presented briefly below. In Section 2.2.3, I argue that the trimoraic syllable approach is the most appropriate analysis for SNA.

³ Superheavy CVCC and CVG syllables appear broken up in slow and careful speech by a non-quality vowel or schwa after the peripheral consonant. Nonetheless, in natural and fast speech, the superheavy syllable remains.

2.2.2.1 Semisyllables

The special status of consonants in Arabic superheavy syllables has garnered attention in the literature: how should we conceptualize the extra weight that appears to be associated with these consonants? Is the so-called additional consonant actually part of the syllable, or is it separate from it? Most recently, Kiparsky (2003) coined the term “semisyllable” to refer to the peripheral or unsyllabified consonants attested in some Arabic dialects. The idea is that these peripheral consonants do not affiliate with a syllable node; instead they carry their own mora which adjoins directly the prosodic word; hence the term “semisyllable.”

In line with the typology of Arabic dialects that we mentioned earlier, Kiparsky’s (2003) classification of Arabic dialects was based on the treatment of semisyllables. According to Kiparsky, Arabic dialects fall into three groups. Two groups (C dialects and VC dialects) permit semisyllables in the word-level phonology. In the post-lexical phonology, however, only C dialects allow semisyllables to surface as VC dialects require an epenthetic vowel before a semisyllable. The last group (CV dialects) do not allow unsyllabified consonants or semisyllables at any level, so an epenthetic vowel is always required after these consonants. The status of semisyllables among the three Arabic dialect types is summarized in (6).

- (6). a. CV dialects: semisyllables are banned at any level.
b. VC dialects: semisyllables are permitted at the word level only.
c. C dialects: semisyllables are permitted at all levels (word/post-lexical levels).

Within OT, semisyllables can be explained by a licensing constraint which dictates that moras should be affiliated with syllables, as shown in (7).

- (7). LICENSE(μ): each mora must be licensed by a syllable node. (Kiparsky, 2000, p. 55)

In CV dialects, LICENSE(μ) is highly ranked, so semisyllables are eliminated in general. Thus, unsyllabified moraic segments never surface; instead, they are always followed by an

epenthetic vowel to become syllabified. The disparity in the VC dialects could be attributed to the different ranking of the constraint LICENSE(μ) in the post-lexical level. Thus, LICENSE(μ) is promoted in post-lexical phonology, and as a result, vowel epenthesis before the consonant is required to satisfy this constraint (Kiparsky, 2003, p. 159). C dialects, in contrast, license semisyllables at both the lexical and post-lexical levels, giving rise to CCC clusters in the surface form. In other words, LICENSE(u) does not get promoted at the post-lexical level.

The notion of semisyllables has been reported in many other languages. For instance, in some Slavic languages, it was reported that non-syllabic sonorants violating SSP only occurred at word edges. In Czech, Rubach and Booij (1990) reported that a word-initial liquid was not syllabic, whereas a liquid in a consonant+liquid sequence was syllabic, i.e., a liquid formed a syllable on its own.

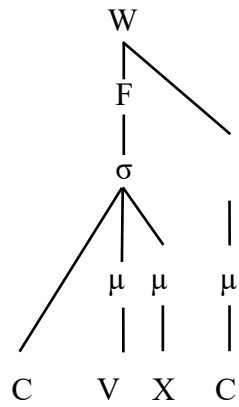
While there is wide agreement on the existence of semisyllables, previous approaches have disagreed on their properties. One question is whether a semisyllable is moraic. The general approach represents semisyllables as licensed moras under the prosodic word (e.g., Buckley, 1994; Hyman, 1985; Itô & Mester, 1992; Kiparsky, 2003; Zec, 1988), as shown in Figure 7, where X could be a consonant or a vowel. Others hold that semisyllables are headless syllables or onset-like consonants and should not be affiliated with a mora (Cho & King, 2003; Nepveu, 1994), as demonstrated in Figure 8.

The argument between moraic and non-moraic representation for these consonants has always been motivated by language-specific considerations, such as visibility to stress or being constrained by position or sonority requirements (Kiparsky, 2003). In fact, in Rulwaili Arabic, semisyllables can be moraic or non-moraic depending on the syllable type; a semisyllable in non-

final CVX.C due to suffixation is moraic because it triggers epenthesis, whereas other semisyllables are not moraic (Al-Solami, 2020, p. 31).

Figure 7

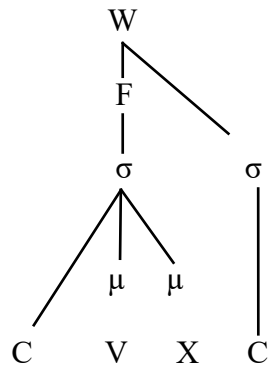
Semisyllables as Licensed Moras



(Kiparsky, 2003, pp. 93–96)

Figure 8

Semisyllables as Headless Syllables



(Cho & King, 2003, p. 193)

2.2.2.2 Mora-Sharing

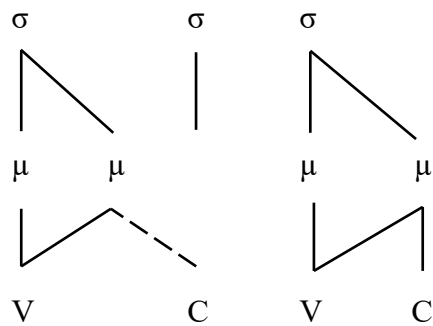
Several works on Arabic dialects have proposed that semisyllables in non-final CVVC or CVCC syllables are not only moraic, but also affiliated with a syllable. For a semisyllable to be included in a syllable node, it must adjoin to an adjacent consonant or vowel by means of mora-sharing. This was proposed in analyses of Lebanese Iraqi, and Egyptian Arabic by Aoun (1979)

and Selkirk (1981). Similar works on Egyptian Arabic by Broselow (1992, 1995) and Broselow et al. (1997) have likewise proposed a mora-sharing approach.

More recently, Watson (2007) argued that non-final CVVC syllables could be represented by allowing the last consonant to share a mora with the preceding vowel, rather than serving as the onset of an epenthetic nucleus. Watson found a new group of Arabic dialects that appeared to be of the CV type, although they exhibited medial CVVC. Watson called this group “Cv dialects.” This structure is illustrated in Figure 9, reproduced from Broselow (1992, pp. 14–15).

Figure 9

Adjunction to Mora



As shown below, SNA allows medial CVVC and CVCC syllables similar to the VC and Cv groups (like San’ani Arabic) described by Watson (2007, p. 351). It is also possible in SNA to have non-final superheavy syllables with a geminate due to syncope (CVGVCVC > CVGCVC), as shown in (8).

- (8). a. /mikallimih/ [mkall.mih] ‘have talked to him’
 b. /milabbisah/ [mlabb.sah] ‘she has dressed him’
 c. /misakkirah/ [msakk.rah] ‘closed (f)’

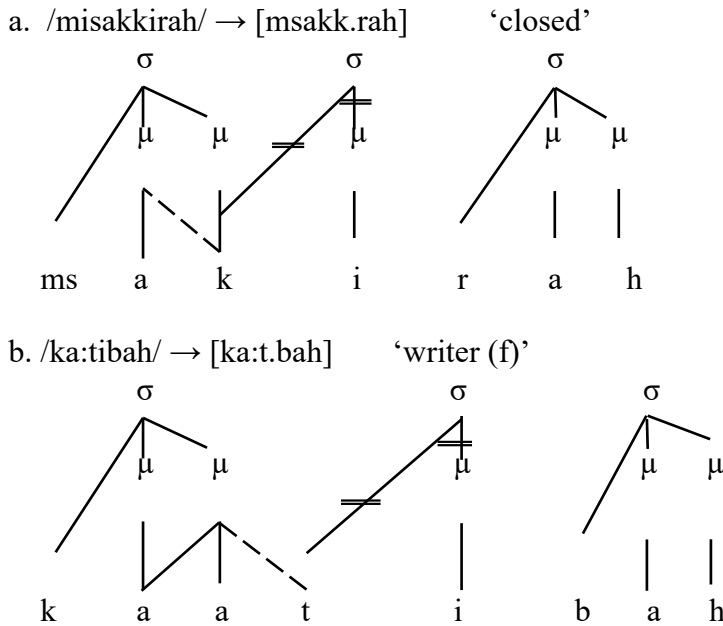
Geminates in these examples in SNA behave like the last consonants of medial CVCC syllables and are not heterosyllabic. If these geminates were analyzed as sharing a mora with the

preceding nucleus vowel, the weight of a superheavy CVGG syllable would be similar to CVC.

This predicts relatively reduced phonetic duration of the geminate or a reduced phonetic duration of the long vowel, as illustrated in Figure 10.

Figure 10

Reduced Geminate or Long Vowel



Kiparsky (2003) stated that non-final CVG syllables could arise without violating the maximum syllable requirement: “syncope is allowed more readily after geminates than after other CC clusters, for shortening of long vowels and of geminates is a way of accommodating to the syllable structure without incurring a melodic MAX- violation” (p. 173).

Mora-sharing was supported by Broselow (1995) and Broselow et al.’s (1997) examination of several dialects of Arabic. Her phonetic production study showed that the duration of the vowel in a CVVC syllable was considerably shorter than that of a CVV syllable, though it was a bit longer compared to the short vowel in a CV or CVC syllable. Similarly, the duration of a geminate in a CVG syllable was shorter than that of a heterosyllabic geminate,

though longer than a singleton CVC. Both sets of results are accounted for, if the final C of a heavy syllable shares a mora with the preceding V or C.

The advantage of the mora-sharing approach lies in its three-way distinction of weight, compared to the two-way distinction in a semisyllable approach. That is, a mora may be unlicensed, licensed but with segments sharing a mora, or licensed but not shared. For moras that are licensed, dialects may license moras at one lexical level (VC group), both lexical levels (C group), or not at all (CV group). Consequently, dialects differ substantially in their tolerance for CVXC syllables, particularly in non-final position.

2.2.2.3 Onset Maximization

Another interesting proposal to represent superheavy syllables is onset maximization, which involves resyllabifying the marginal consonant in a CVXC syllable with the following syllable, even if that syllable already has an onset. This leads to complex onsets rather than complex codas, i.e., CVX.CCVC instead of CVXC.CVC. Although most researchers have not argued for such a proposal, Bamakhramah (2009) described Arabic dialects that used onset maximization as a repair strategy to avoid word-medial superheavy syllables. Bamakhramah argued that onset maximization was a preferred strategy because complex onsets were generally attested in Urban Hijazi Arabic due to syncope, and therefore complex codas could be avoided word-medially by resyllabifying the final consonant as part of the following syllable. Further evidence was derived from the fact that Hijazi Arabic did not allow CVCC syllables word-finally, so it would be intuitive that such syllables would not be tolerated word-internally. Similarly, Alahmari (2018) argued that superheavy syllables could be avoided in Southern Saudi Arabic by onset maximization, though this strategy was restricted to certain types of syllables in certain environments, i.e., geminates in CVVG or CVXC that were associated with syncope.

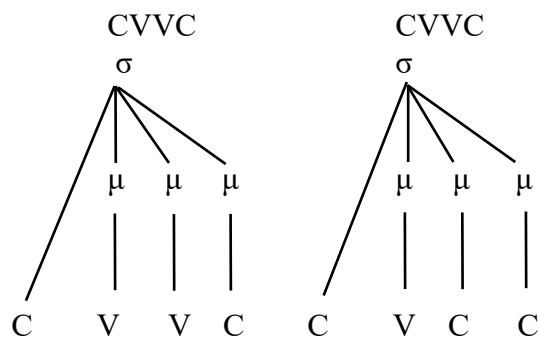
While the concept of onset maximization appears to have a legitimate basis for some dialects, it is not applicable to SNA. First, the assumption that a superheavy syllable is actually a heavy syllable with a following complex onset does not work, because there is evidence that superheavy syllables in SNA contain extra weight. Second, parsing a sequence of medial consonant clusters as C.CC rather than CC.C should not trigger epenthesis in cases where sonority principles are compromised. These observations are detailed in Chapters 5 and 6.

2.2.2.4 Trimoraic Syllables

The representation of superheavy syllables has been controversial. In the literature, the basic claim is that syllables are maximally bimoraic, and syllables which seem to be otherwise (superheavy) should be configured as bimoraic plus an extrasyllabic element or stray consonant (McCarthy & Prince, 1986; Shaw, 1996; Sprouse, 1996; Steriade, 1991). The opposing view is that trimoraic syllables should be accounted for, at least in some cases (e.g., Aoun, 1979; Davis, 2011a; Hayes, 1989; Morén, 1999). Trimoraic syllables are depicted in Figure 11.

Figure 11

Trimoraic Syllables



The three-way weight distinction is not uncommon by any means. Several languages appear to have stress assignment based on the heaviest syllables in the word. One such example is Hindi, as reported by Kelkar (1968), in which stress was shown to fall on the heaviest syllable

of the word regardless of its position. Thus, if there is one superheavy syllable (CVVC, CVCC), it always gets stressed. More recently, Alhuwaykim (2018) proposed that Northwestern Saudi Arabic possessed trimoraic syllables based on stress patterns in the dialect.

As should be apparent from the diagrams, the three-way weight distinction in this approach consists of syllables with one, two, or three moras, and therefore differs from the three-way distinction suggested by the mora-sharing approach.

2.2.3 Selecting an Approach

Thus far, this chapter has reviewed several approaches to representing superheavy syllables. Although it would seem each approach could work for analyzing SNA, I argue in favor of a trimoraic account for three reasons. First, mora-sharing has been shown to have phonetic implications such as vowel shortening and degemination (cf. Watson, 2007), which is beyond the scope of this study. Second, the onset maximization and semisyllable approaches fall short in explaining some of the phonological aspects of SNA, particularly in stress assignment rules. As I demonstrate at length in Chapter 5, superheavy and heavy syllables appear to behave differently in terms of attracting stress, e.g. *ka:t.'bi.tih* ‘his female writer’ vs. *'mak.ti.bah* ‘library.’ Therefore, their weights should be distinct. If both syllable types are assumed to have the same weight, an explanation is needed for the discrepancies in their interaction with stress.

The third argument for a trimoraic approach is the epenthesis in some types of final and non-final CVCC syllables to repair situations in which derived coda clusters exhibit rising sonority requirements. This is another unique feature of SNA and strongly suggests that the consonant is part of the syllable. The epenthesis is realized in both underlying CVCC stems (after affixation only) or CVCC syllables derived through syncope. What is interesting is the

observation that SNA allows epenthesis only before the last, arguably unsyllabified, consonant. Therefore, this type of epenthesis must be required by sonority requirements, as shown in (9).

- | | | | |
|------|---------------|------------|-----------------------|
| (9). | a. /ħukm/ | [ħukum] | ‘decision’ |
| | b. /ʔism/ | [ʔisim] | ‘name’ |
| | c. /ʃakl/ | [ʃakil] | ‘shape’ |
| | d. /ħukm-hum/ | [ħukumhum] | ‘their decision’ |
| | e. /ʔism-ha/ | [ʔisimha] | ‘her name’ |
| | f. /ʃakl-kum/ | [ʃakilkum] | ‘your (plural) shape’ |

Note that epenthesis also occurs in the suffixed forms of (9d, e, f). For these words which contain triple consonant cluster CCC, the medial consonant cannot be part of the onset of the following syllable, *[ħuk.mhum]. An alternative syllabification would be *[ħukm.hum], with the medial [m] as a semisyllable. However, if the medial consonant was a semisyllable and attached to the prosodic word rather than a syllable (or indeed, even if it was in the onset of the next syllable), it would be hard to explain why such forms would require this kind of epenthesis. The only explanation is if the dialect respects the Syllable-Contact Law, as articulated in (10) by Murray and Vennemann (1983).

- (10). Syllable Contact Law: In a syllable-contact pair, it is better to have a falling sonority slope.

This solution was suggested by Al-Hammad (2018) in analyzing coda clusters in Najdi Arabic. However, her suggestion was that Najdi only enforced the Syllable-Contact Law between a syllable coda and a more sonorous semisyllable. Notably, the dialect does not enforce the law across sequences of two syllables, which would be problematic for this account. In this dissertation, I claim that the final consonant is actually part of the syllable in SNA and therefore must conform to SSP. Consequently, if epenthesis in monosyllabic CVCC words appears to conform to SSP, it must do the same for non-final superheavy syllables after affixation.

One could argue the epenthesis in (9d-f) takes place before affixation, and therefore has no bearing on our argument. However, the stress location challenges this claim, given that stress should alter when affixation takes place. This argument is explored further in Chapters 5 and 6.

Interestingly, CVCC syllables in non-final position derived from syncope show a similar vowel insertion. That is, CVCC syllables resulting from high vowel deletion (CVCiC > CVCC) may also trigger epenthesis if there is a sonority rise in the coda cluster. Thus, in addition to syncope, a vowel is inserted in the stem cluster, CCvC > CvCC, which presents a situation that looks like metathesis, as shown in (11).

- (11). a. /jadʒlis-u:n/ [ja.dʒil.su:n] ‘they sit down’
 b. /tatʰlub-u:n/ [ta.tʰul.bu:n] ‘they ask for’
 c. /jasrug-ih / [ja.sur.gih] ‘he steals it’

In (11), not only is the high vowel deleted, but also an epenthetic /i/ is added between the first and second consonants. These examples cast doubt that the epenthesis in (9d-f) may be prior to affixation. Based on these observations, I suggest that words in (11) must undergo syncope first. Compare the examples in (11) with a word form as in (4), e.g., /jaktubu:n/ → [jaktbu:n] ‘they write,’ where only syncope is attested. Subsequently, epenthesis occurs to repair the cluster with a rising sonority, as in the forms in (9).

Given the facts about both stress assignment and epenthesis, I conclude that CVXC syllables are best analyzed as containing three moras. In the following section, I represent all syllables shapes of SNA within the framework of OT.

2.3 Representation of Syllable Types in OT

Previously, I demonstrated how so-called superheavy syllables are tolerated in SNA. In this section, I analyze these patterns using a set of constraints which eventually determine the shape of the syllables. Under traditional moraic theory, syllables should not exceed a maximum

(bimoraic) weight, and stray or unparsed consonants are strongly prohibited. Alternatively, a moraic consonant may be permitted under the prosodic word not dominated by a syllable. In order to illustrate a basic OT analysis, I adopt this assumption for now, but I will later revisit this issue later in light of my observation that syllables in SNA can indeed be trimoraic.

To achieve a desirable situation, I use the pair of inviolable constraints SYLLBIN and LICENSE-C to determine the moraic content of syllables. Additionally, I incorporate a violable constraint Syl- μ that disfavors syllables that are not assigned any moras, i.e., semisyllables.

2.3.1 Syllable Representation

The first step in this process is to establish how syllable weight is determined. The basic markedness constraints for syllable constructions lie in the formation around the nucleus of a syllable. Cross-linguistically, it is preferred for syllables to start with an onset and to avoid codas as much as possible. Jakobson (1962) defined this universal tendency as follows: “There are languages lacking syllables with initial vowels and/or syllables with final consonants, but there are no languages devoid of syllables with initial consonants or of syllables with final vowels” (p. 526). This typology is defined in OT by markedness and faithfulness constraints, as in (12) and (13) (McCarthy and Prince, 1995; Prince and Smolensky, 1993, 2004)

- (12). Markedness Constraints:
 - a. ONS: Syllables must begin with onsets.
 - b. *COD: Syllables should not contain codas.

- (13). Faithfulness constraints:
 - a. MAX-IO: Each input segment has a corresponding output segment (no deletion).
 - b. DEP-IO: Each input segment has a corresponding output segment (no epenthesis).

The competition between these constraints determines the shape of the syllable in a language. Given that all syllables in SNA start with an onset, ONS must be undominated. On the other hand, closed syllables with codas, including complex codas, are attested. Therefore, *COD

must be dominated by ONS: ONS >> DEP, MAX >> COD. The postulated ranking of these constraints is crucial for understating how syllables are constructed in SNA, as shown in (14).

(14). *Postulated Ranking of Constraints in SNA*

CVC	ONS	DEP-IO	MAX-IO	*COD
a. C.VC	*!			
b. CVC				*
c. CV			*!	
d. CVCv		*!		

Recall that in OT, EVAL assigns a violation mark (*) for each violation of a particular constraint. Violations that are fatal, i.e., that remove the candidate from the competition, are marked with an exclamation point (!). Constraints that are not crucially ranked relative to one another, such as DEP-IO and MAX-IO in Table 5, are separated by a dashed line rather than a solid line.

The evaluation in Table 5 selects (b) as the optimal candidate, which satisfies the undominated markedness and faithfulness constraints. Before moving on to heavy syllables, it is worth mentioning that complex margins are not exclusive to codas. In fact, SNA allows almost every syllable type with an initial CC. This complex margin can be explained by one violable constraint stated in (15).

(15). COMPLEX_{ONS} (COM_{ons}): A syllable must not contain more than a single onset segment.

Although complex consonant clusters occur, their distribution shows that they are restricted to word-initial syllables, after syncope (high vowel deletion and trisyllabic elision). On this basis, I argue that complex onsets are actually prohibited in the dialect. Rather, word-initial CC strings are composed of a semisyllable consonant followed by a syllable. This semisyllable analysis differs from Kiparsky (2003), who assumed consonants were moraic. Instead, I propose that semisyllables are restricted to the (word-initial) periphery in SNA and do not add to syllable

weight. To achieve this morales semisyllable, it must be established that a semisyllable is a consonant under a semisyllable node. The only difference between a syllable and semisyllable is the mora. Following Cho and King (2003), I have used the constraint in (16).

(16). Syllable Mora (Syl- μ): Every syllable should contain a mora. (p. 197)

This constraint militates against any semisyllable in the prosodic word and can be modeled with a direct conflict between COM_{ONS}. Postulating COM_{ONS} as an undominated constraint, a semisyllable may be allowed in a sequence of C.C: COM_{ONS} >> Syl- μ .

(17). *Semisyllable in C.C Sequence*

CCVC	ONS, COM _{ONS}	DEP-IO	MAX-IO	Syl- μ	*COD
a. CCVC	*! COM _{ONS}				*
b. C.CVC				*	*
c. CVC			*!		*
d. Cv.CVC		*!			*

The evaluation shows that CCVC is not possible because the top-ranked constraint COM_{ONS} will be violated. Instead, the initial consonant is left unparsed at the cost of Syl- μ . This postulated ranking is crucial throughout the dissertation for understanding several phenomena.

At this point, my analysis of SNA syllables has abandoned the notion of semisyllables to account for heavy final syllables, which I claim are actually trimoraic. At the same time, I have retained the notion of semisyllables to account for complex onsets, which crucially only occur in word-initial position, therefore lending themselves naturally to a semisyllable analysis.

2.3.2 Heavy Syllables

In SNA, as in most Arabic dialects, CVV and CVC syllables appear to have the same weight. This would indicate that coda consonants must be linked to a mora. To account for a core syllable CVC, or CVV, I shall use the constraint in (18), which was introduced earlier in Chapter 1 by the Wight-By- Position Rule (Hayes, 1989).

(18). Weight-By-Position (WBP): a coda consonant is represented with a mora.

Given this constraint, moras can be assigned to coda consonants only. Since vowels are underlyingly moraic, this constraint interacts with a competitor constraint to derive the desired syllable shape. A faithfulness constraint in (19) proposed by McCarthy (2000a) dictates that each surface mora must be matched to the input.

(19). DEP- μ : Each output mora must have a corresponding input mora.

The interaction between these two constraints determines the shape of the output, and to derive a moraic coda consonant, the constraint WBP must outrank DEP- μ (WBP \gg DEP- μ).

(20). *WBP* \gg *DEP- μ*

μ CVC	WBP	DEP- μ
μ a. CVC	*!	
μ μ b. CVC		*

While candidate (a) violates WBP for not linking a coda consonant to a mora, candidate (b) violates DEP- μ by adding a mora that is not represented in the underlying form.

Consequently, the relative ranking of the constraints determines that (b) is the optimal form.

2.3.3 Representation of Superheavy Syllables

2.3.3.1 CVCC and CVVC

In previous sections, we evaluated several possible representations of superheavy syllables, including semisyllables, mora-sharing, and trimoraicity. As we turn to analyzing superheavy syllables in OT, we will first consider traditional approaches that have incorporated semisyllables and mora-sharing into constraint rankings. Doing so will allow me to demonstrate

the basics of how OT handles syllables, but more importantly, to demonstrate why the trimoraic solution is ultimately superior for the behavior of SNA syllables.

Table 8 shows a possible OT tableau which would permit superheavy syllables as trimoraic. Assuming the coda must be linked to a mora means that syllables with complex codas may have three moras. In (21), OT evaluates two possible candidates and selects (b) as optimal. Although each incurs the same number of violations, (b) violates the lower-ranked constraint.

(21). *Possible Representation of Superheavy Syllable in SNA*

μ CVCC	WBP	DEP- μ
μ a. CVCC	*!*	
μ μ μ b. C V C C		**

Although the ranking in Table 8 permits of the trimoraic syllable, most previous works have agreed that the maximal weight in Arabic vernaculars is bimoraic. One general constraint was by suggested by Watson (2007) in (22).

(22). SYLLBIN: A syllable must not exceed two moras. (Watson, 2007, p. 350)

Given this constraint, trimoraic syllables should not be allowed. For this reason, Kiparsky (2003) proposed that from a representational standpoint, superheavy syllables do not exist in Arabic dialects. Rather, CVXC can be modelled as a heavy syllable followed by a moraic consonant known as a semisyllable. Therefore, instead of parsing trimoraic syllables, or even bimoraic syllables with mora-sharing, a string of CVXC is actually a heavy syllable of CVX plus a moraic semisyllable C. Under this analysis, the interaction of the constraints in (23) and (24) determines the shape of the output in SNA.

(23). LICENSE- μ : All moras must be licensed under syllables. (Kiparsky, 2003)

(24). LICENSE-C: All segments must be licensed under syllables or moras. (Kiparsky, 2003)

While the former constraint militates against moras that are not parsed under syllables, the latter militates against stray consonants that are not part of a syllable or a mora. To allow a semisyllable, the constraint LICENSE- μ has to be dominated by LICENSE-C: WBP, LICENSE-C >> LICENSE- μ >> DEP- μ .

To rule out superheavy syllables while satisfying WBP, Kiparsky suggested a moraic peripheral consonant, which is parsed to the prosodic word as in candidate (a) as in (25).

(25). WBP, LICENSE-C >> LICENSE- μ >> DEP- μ

μ CVCC	SYLLBIN, WBP, LICENSE-C	LICENSE- μ	DEP- μ
<p>a. C V C C</p>		*!	*
<p>b. C V C C</p>	*! SYLLBIN		**
<p>c. C V C C</p>	*!* WBP		
<p>d. C V C C</p>	*! LICENSE-C		

However, this does not mean that stray consonants are possible, so another top constraint, LICENSE-C, eliminates forms like (d).

A major challenge to the theory of semisyllables is moraic representation, as it is not clear how semisyllables acquire their moras if they are not part of a syllable. Since superheavy syllables can arise due to syncope or affixation, the assumption that each peripheral consonant would be moraic but not affiliated with a syllable needs further explanation.

As reviewed earlier, a different approach suggested by Watson (2007) is mora-sharing, which addresses the representation of unique superheavy syllables in some Arabic vernaculars such as San’ani Arabic. Following Broselow et al. (1997), Watson adopted this constraint:

(26). No-Shared-Moras (NS μ): “Moras in the output are linked to a single segment.”

(Broselow et al. 1997, p. 65).

As this constraint is defined, moraic segments should not share moras as shown in (27).

(27). *SYLLBIN* >> NS μ

μ CVCC	SYLLBIN, WBP, LICENSE-C	DEP- μ	NS μ
<p>a. C V C C</p>		*	*
<p>b. C V C C</p>	*! SYLLBIN	**	
<p>c. CVCC</p>	*!* WBP		
<p>d. C V C C</p>	*! LICENSE-C		

By ranking this constraint low, however, dialects of Arabic can have bimoraic superheavy syllables by allowing the final consonant to share a mora with a preceding vowel or consonant. Although Watson's (2007) analysis was restricted to CVVC and CVG syllables when vowel shortening and degemination failed to apply, the basic principle is that mora-sharing can be violable depending on the dialect. While this proposal appears to work well for many Arabic dialects, it does not work with SNA for two reasons. First, as discussed in detail in Chapter 5, all types of superheavy syllables (CVVC, CVG, CVCC) show a different behavior and carry more weight, arguably more moras, word-internally and word-finally compared to core heavy syllables (CVV and CVC). Assuming superheavy syllables are bimoraic is therefore inadequate in this regard. Second, mora-sharing can be problematic for other types of syllables as well. If NS μ is low ranked in SNA, there should be no difference between CVC and CV syllables because both can be represented by a single mora. That is, the CVC syllable allows the coda to share a mora with the preceding vowel to avoid a violation of the higher-ranked constraint DEP- μ .⁴ This turns out to be problematic because heavy syllables must attract stress, as shown in (28).

(28). *Heavy Syllables Must Attract Stress*

μ CVC	WBP	DEP- μ	NS μ
μ b. CVC	*!		
μ μ ⊖ b. CVC		*	
μ ↘ ⊖ c. CVC			*

⁴ Watson's (2007) proposal for mora-sharing was restricted to CV and Cv dialects, but the assumption was that NS μ was only violable if dominated by DEP- μ .

The claim that NS μ is violable in SNA incorrectly predicts structures like candidate (c) in (28) to be optimal. To rule out such a scenario, consonants must be linked to their own moras and add to the syllable weight. To solve this, I argue that NS μ must be a top-ranked constraint in SNA.

Ranking NS μ as the most dominant constraint rules out candidate (c). Therefore, the desired candidate (b) is evaluated as the optimal form, as shown in (29). Along the same lines for superheavy syllables, I propose that SNA allows trimoraic syllables. Hence, SYLLBIN should be ranked low in the grammar.

(29). *NS μ Must Be a Top-Ranked Constraint*

μ CVC	NS μ WBP	DEP- μ
μ a. CVC	*! WBP	
μ μ b. CVC		*
μ / \ c. CVC	*! NS μ	

Although trimoraic syllables could be expected to have high markedness cross-linguistically, several works have provided data to support their existence (e.g., Aoun, 1979; Hayes, 1989; McCarthy, 1979a; Davis, 2011a; Morén, 2013). Furthermore, OT does not completely ban any structure, such as trimoraic syllables. This turns out to be one of the advantages of OT as it allows marked structures to be formalized in a simple fashion. Other frameworks would either suggest a ban on trimoraic syllables completely without justification or allow them to appear without restriction.

In (30), it is shown that ranking SYLLBIN low allows candidates with trimoraic syllables as in (b) to be optimal. Forms like (a) and (c), on the other hand, are ruled out since they trigger fatal violations of NS μ and WBP, respectively. Similarly, forms with an unparsed stray consonant fatally violate LICENSE-C.

(30). *CVCC in SNA*

μ CVCC	NS μ , WBP, LICENSE-C	DEP- μ	SYLLBIN
<p>a. C V C C</p>	*! NS μ	*	*
<p>b. C V C C</p>		**	*
<p>c. C V C C</p>	*!* WBP		
<p>d. C V C C</p>	*! LICENSE-C	*	

Establishing this constraint ranking means that trimoraic CVCC syllables are possible only to satisfy higher constraints, such as NS μ , WBP, and LICENSE-C.

Similarly, this model can be tested for other types of superheavy syllables. In (31) the suggested ranking shows how CVVC are represented within this analysis. The tableau successfully predicts a similar outcome for CVVC syllables. Even though parsing a superheavy syllable incurs a violation of SYLLBIN in addition to DEP- μ , the evaluation renders the form in (b) to be optimal for satisfying the higher-ranked constraints. On the other hand, the tableau rules

out candidate (a) for allowing the consonant to share a mora, (c) for not assigning a coda consonant to a mora, and (d) for leaving an unparsed stray consonant.

(31). *CVVC in SNA*

$\mu \mu$ CVVC	NS μ , WBP, LICENSE-C	DEP- μ	SYLLBIN
<p>a. C V C C</p>	*! NS μ	*	*
<p>b. C V V C</p>		*	*
<p>c. C V V C</p>	*!* WBP		
<p>d. C V V C</p>	*! LICENSE-C	*	

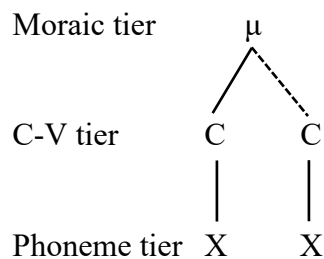
2.3.3.2 Superheavy Syllables with Geminates

Thus far, the study has indicated that superheavy syllables in SNA are trimoraic. Nonetheless, two other types of superheavy syllables have not been tested: CVG and CVVG. CVVG and CVG can appear in SNA with contained geminates, i.e., geminates that belong to one syllable. The status of geminates is, however, less clear than other consonants. In moraic theory, geminates are suggested to be inherently moraic (Davis, 1994, 2011b; Hayes, 1989). The argument for underlying moraic representation for geminates stems from the observation that CVG syllables behave differently from CVC in numerous languages when interacting with stress, even in word-final position.

In addition to underlying moraicity, geminates are assumed to occupy two C slots. Clements and Keyser (1983) and Hayes (1989) suggested that geminates in some languages can also be analyzed as two C slots corresponding to one lengthened consonant on the C-V tier. This lengthening can be represented at the higher dominating level (moraic tier) by allowing the rightmost C slot to share a mora with the preceding C slot, as shown in Figure 12.

Figure 12

Rightmost and Preceding C Slots Sharing a Mora



This claim is not problematic for an intervocalic geminate in CVG syllables, given that the first part of the geminate is in the coda. The coda in a CVG syllable would not be distinguished from a singleton consonant in a CVC syllable, where the coda is also moraic. The only difference is that a geminate is inherently moraic whereas a singleton acquires its mora by the WBP rule. The challenge lies in accounting for contained geminates where the geminate belongs to one syllable. To be consistent with the analysis so far, a CVG with contained geminates could be seen as trimoraic rather than being doubly linked to one mora. This does not exclude the assumption that geminates are underlyingly moraic. Under this representation, contained geminates should be assigned one additional mora to satisfy the WBP rule given that the second part of the geminate also occurs in coda position.

In (32), the tableau shows that a heavy syllable with contained geminates in coda position is similar to a CVCC syllable where each C slot in the coda must be attached to one mora;

otherwise, it fatally violates WBP. Linking two consonants (or a geminate in this case) to a single mora incurs a violation of NS μ . A key difference from CVCC syllables analyzed in (30) is that, for CVG syllables in (32), DEP- μ incurs only one violation since the geminate already has one mora in the input, and leaving the second consonant or second part of a geminate unparsed marks a fatal violation of LICENSE-C. As a result, candidate (b) is rendered optimal in this tableau.

(32). *CVG in SNA*

$\mu \mu$ CVG.	NS μ , WBP, LICENSE-C	DEP- μ	SYLLBIN
<p>a. C V C C</p>	*! NS μ	*	*
<p>b. C V C C</p>		*	*
<p>c. C V C C</p>	*! WBP		
<p>d. C V C C</p>	*! LICENSE-C	*	

So far, I have argued that a superheavy syllable exists in SNA with a trimoraic representation. The argument is that the SYLLBIN constraint, which requires syllables to contain a maximum of two moras, must be ranked low in the dialect. This current ranking does not yet present a comprehensive analysis, however. In theory, for example, the grammar could reduce complex codas by deleting a consonant or inserting a vowel, as shown in (33).

(33). *Reducing Complex Codas by Deleting a Consonant or Inserting a Vowel*

μ CVCC	NS μ , WBP, LICENSE-C	DEP- μ	SYLLBIN
<p>a. C V C C</p>	*! NS μ	*	*
<p>⊖ b. C V C C</p>		*!*	*
<p>c. C V V C</p>	*!* WBP		
<p>d. C V C C</p>	*! LICENSE-C	*	
<p>e. C V V C v</p>		*!*	
<p>⊕ f. C V V</p>			

Candidates (e) and (f) equally satisfy all the top constraints introduced so far. Therefore, to avoid deleting the final consonant in the superheavy syllable, or inserting a vowel next to it, the analysis needs to include faithfulness constraints, i.e., MAX-IO and DEP-IO. These constraints must outrank DEP- μ and SYLLBIN to derive (b) as the optimal form over (f), as shown in (34): NS μ , WBP, LICENSE-C, DEP-IO, MAX-IO >> DEP- μ , SYLLBIN.

(34). *MAX-IO and DEP-IO*

μ CVCC	NS μ , WBP, LICENSE-C	DEP-IO MAX-IO	DEP- μ	SYLLBIN
<p>a. C V C C</p>	*! NS μ		*	*
<p>b. C V V C</p>			*	*
<p>c. C V V C</p>	*! * WBP			
<p>d. C V V C</p>	*! LICENSE-C		*	
<p>e. C V V C v</p>		*! DEP-IO	**	
<p>f. C V V</p>		*! MAX-IO		

Adding the pair of faithfulness constraints solves the issue introduced in (33). In (34) even though adding a vowel or deleting a consonant does not violate the top-ranked constraints, it still triggers a violation of DEP-IO or MAX-IO, respectively. Consequently, the desired form (b) is mapped as the optimal form.

With this ranking established, let us turn to testing it on the actual dataset from SNA.

First, I begin with words that have superheavy syllables due to suffixation. The evaluation in (35), (36), and (37) shows three different shapes of superheavy syllables.

(35). *Evaluation of [ba:b.na] ‘Our Door’*

$\mu\mu$ /ba:b-na/	NS μ , WBP, LICENSE-C	DEP-IO MAX-IO	DEP- μ	SYLLBIN
$\mu\mu$ a. baab.na	*! NS μ			*
$\mu\mu\mu$ b. baab.na			*	*
$\mu\mu$ c. baab.na	*! WBP			
$\mu\mu$ d. baa.b.na	*! LICENSE-C			
$\mu\mu$ e. baa.bi.na		*! DEP-IO	*	
$\mu\mu$ f. baa.na		*! MAX-IO		

(36). *Evaluation of [bintha] ‘Her Daughter’*

μ /bint-ha/	NS μ , WBP, LICENSE-C	DEP-IO MAX-IO	DEP- μ	SYLLBIN
$\mu\mu$ a. bint.ha	*! NS μ		*	*
$\mu\mu\mu$ b. bint.ha			**	*
μ c. bint.ha	*!* WBP			
$\mu\mu$ d. bin.t.ha	*! LICENSE-C		*	
$\mu\mu$ e. bin.ti.ha		*! DEP-IO	*	
$\mu\mu$ f. bin.ha		*! MAX-IO		

(37). *Evaluation of [ħadd.ni] ‘He Forced Me’*

$\mu\mu$ /ħadd-ha/	NS μ , WBP, LICENSE-C	DEP-IO MAX-IO	DEP- μ	SYLLBIN
$\mu\mu$ a. ħadd.ni	*! NS μ			
$\mu\mu\mu$ b. ħadd.ni			*	*
$\mu\mu$ c. ħadd.ni	*! WBP			
$\mu\mu$ d. ħad.d.ni	*! LICENSE-C			
$\mu\mu$ e. ħad.di.ni		*! DEP-IO	*	
$\mu\mu$ f. ħad.ni		*! MAX-IO		

Across these three tableaux, the derivation for each syllable is similar; in each case, the optimal forms are in (b), even though these violate the low-ranked constraint SYLLBIN. Parsing a superheavy syllable with two moras is ruled out by one of two constraints; the forms in (a) are parsed by means of mora-sharing, which incurs a violation of NS μ , whereas the forms in (c) incur a fatal violation of WBP. Forms which leave the consonant unparsed lead to a violation of LICENSE-C, as in (d). Finally, deleting the final consonant in CVXC or inserting a vowel to resyllabify it triggers a violation of faithfulness constraints MAX-IO and DEP-IO, respectively.

This constraint ranking works for the data examined so far. Next, I turn to syllables derived by a different mechanism. Some apparently superheavy syllables are derived from syncope, for instance, through high vowel deletion. To model this, I assume for now that high vowels are not permitted in open syllables in SNA. One such constraint was proposed by Kenstowicz (1996) in (38).

(38). *i]σ: High short unstressed vowels are prohibited in open syllables.

If this constraint is highly ranked, high short vowels should not appear in the surface. Later, I explain this is not actually what is going on, as there are countless cases where unstressed high vowels appear in the surface. Nonetheless, this constraint is used for now to show how syncope interacts with the rest of the proposed constraints, as presented in (39).

(39). *Evaluation of [jaktbu:nih] ‘They Write It’*

$\mu \mu$ /jaktub-u:n-ih/	NS μ , WBP, LICENSE-C, *i]σ	DEP- IO	MAX- IO	DEP- μ	SYLLBIN
$\mu\mu$ a. jakt.buu.nih	*! NS μ		*	**	
$\mu\mu$ b. jakt.buu.nih	*! WBP		*	*	*
$\mu\mu$ c. jak.t.buu.nih	*! LICENSE-C		*	*	
$\mu\mu \mu$ d. jak.tu.buu.nih	*! i]σ			*	
$\mu\mu\mu$ e. jakt.buu.nih			*	**	*
$\mu\mu$ f. jak.buu.nih			*!*	*	

Due to the high ranking of *i]σ, an underlying high vowel must be deleted. This, however, cannot be at the cost of the most dominant constraints, i.e., (a) through (c). Note that I represent (a) and (b) with similar conventions, although their mechanism is distinct. While candidate (a) allows mora-sharing, (b) does not assign the last consonant a mora, which triggers a violation of WBP. Similarly, leaving an unparsed stray consonant is fatal due to LICENSE-C. As a result, the established ranking suggests that form (e) is optimal, which is the desired output. Compared to candidate (f), which also avoids violations of top constraints, this is still rendered less faithful to the input, as deleting two segments incurs a fatal violation of MAX-IO.

Analogously, non-final CVVC and CVG should be evaluated by the same mechanism. In (40 and (41) I show how this model evaluates the words [ka:tbah] ‘writer (f)’ and [sakkrih] ‘Close it!’

(40). Evaluation of [ka:tɒh] 'Writer (f)'

$\mu\mu$ /ka:tɒh/	NS μ , WBP, P LICENSE-C, *i]σ	DEP-IO MAX-IO	DEP- μ	SYLLBIN
$\mu\mu$ a. ka:t.bah	*! NS μ			
$\mu\mu$ b. ka:t.bah	*! WBP		*	*
$\mu\mu$ c. ka:t.bah	*! LICENSE-C			
$\mu\mu$ d. ka:ti.bah	*! i]σ			
$\mu\mu\mu$ ☞ e. ka:t. bah			*	*
$\mu\mu$ f. ka:.bah		*!* MAX-IO		

(41). Evaluation of [sakkrih] 'Close It!'

$\mu\mu$ /sakkrih/	NS μ , WBP, LICENSE-C, i]σ	DEP-IO MAX-IO	DEP- μ	SYLLBIN
$\mu\mu$ a. sakk.rih	*! NS μ			
$\mu\mu$ b. sakk.rih	*! WBP		*	*
$\mu\mu$ c. sak.k.rih	*! LICENSE-C			
$\mu\mu$ d. sak.ki.rih	*! i]σ			
$\mu\mu\mu$ ☞ e. sakk.rih			*	*
$\mu\mu$ f. sak.rih		*!* MAX-IO		

The tableaux show a similar pattern where the desired forms in (e) are optimal. The forms in (a) delete the vowel and satisfy *i]σ but are ruled out for parsing a superheavy syllable with two moras via mora-sharing. Similarly, not assigning a mora to a consonant in the coda position violates WBP, as in (b). Forms like in (c) are also eliminated for leaving stray consonants unparsed. Finally, forms like in (f) show a violation of the faithfulness constraint MAX-IO, so deleting an underlying consonant in addition to the vowel is not an option.

2.4 Conclusion

This chapter demonstrated the theoretical principles required to represent the syllable and mora. It has suggested that SNA is unique because it permits superheavy syllables word-internally in addition to word-finally. Evaluating some of the well-known models for superheavy syllables in Arabic phonology, I argued in favor of a trimoraic syllable representation that, unlike other approaches, has the potential to show that superheavy syllables can be distinguished from other types of heavy syllables in terms of moraic weight and their conformity to sonority requirements. This claim is explored further in the following chapters. In the second half of this chapter, I introduced OT and showed how this model has strong potential for handling the target dataset. In addition to accounting for syllabification patterns in general and superheavy syllables in particular, the following chapters analyze some of the processes involved in syllable structure.

Chapter 3: Vowel Processes in SNA

3.1 Introduction

This chapter explores challenges raised by previous analyses of modern Arabic vernaculars, particularly Bedouin dialects in the Arabian Peninsula. It discusses four phonological processes: vowel raising, high vowel deletion, trisyllabic elision, and feminine suffix vowel deletion. Previous analyses have generally treated vowel raising and syncope as if they occurred independently of one another. One of the aims of this dissertation is to show that some of these processes are not fully independent but rather share the same underlying motivation. This chapter analyzes these processes in light of data from SNA by relating vowel raising and high vowel deletion to one scalar change, duration reduction. Furthermore, the chapter seeks to unify trisyllabic elision and feminine suffix vowel deletion by prosodic and morphological alignment constraints. Finally, it discusses challenging forms that seem to exhibit opacity and, using Stratal OT, shows that such structures can be resolved.

3.2 Previous Research on Vowel Processes

3.2.1 Vowel Raising, High Vowel Deletion, and Trisyllabic Elision

As mentioned in Chapter 1, most Bedouin dialects are reported to have common vowel processes pertaining to open syllables only. Vowel raising, high vowel deletion, and trisyllabic elision were first described in Northern Najdi by Abboud (1979) using a linear model.⁵ According to Abboud, these processes all targeted short vowels in light non-final syllables; in addition, trisyllabic elision required a sequence of low vowels. A similar approach was reported by Al-Mozainy (1981) for Bedouin Hijazi Arabic. Rule ordering plays an important part in this

⁵ Abboud used the term “low vowel deletion” to describe trisyllabic elision.

analysis. Since low vowels get raised and high vowels get deleted in the same environment, high vowel deletion must occur prior to vowel raising. Otherwise, high vowels would also elide. This is illustrated in the examples in (1), taken from Al-Mozainy's (1981) analysis of Bedouin Hijazi Arabic, though Najdi Arabic could be relevant here.

(1). Rule Ordering

Underlying forms:	/katab/	/katab-at/	/kitib/	/kitib-at/
	'he wrote'	'she wrote'	'he was written'	'she was written'
Initial syllabification:	ka.tab	ka.ta.bat	ki.tib	ki.ti.bat
High vowel deletion:	—	—	ktib	kit.bat
Trisyllabic elision:	k̄ta.bat	—	—	—
Raising:	ki.tab	k̄ti.bat	—	—
Surface forms:	[kitab]	[ktibat]	[ktib]	[kitbat]

This interaction provides the desired surface forms, as far as these examples show.

However, these rules and their ordering are problematic for SNA. For high vowel deletion in SNA, the first vowel in passive forms does not undergo syncope. Instead, the second vowel is deleted, yielding surface forms such as [kitb] 'was written.' In addition, high vowel deletion in SNA shows a pattern in a sequence of two high vowels, e.g., /kitibat/> [kitbit] 'it was written,' where the second high vowel always gets elided, rather than the first vowel as in the Bedouin Hijazi data above. In trisyllabic elision in SNA, on the other hand, when there is a sequence of low vowels, usually the first vowel is deleted. A further explanation is necessary to understand these processes. Previous analysts have pursued such explanations by using lexical phonology or OT. As discussed below, while these explanations possess certain advantages, their applicability to SNA raises problems addressed in this dissertation.

Starting with vowel raising and high vowel deletion, Al-Qahtani (2014) attempted to explain the two vowel processes in Najdi Arabic by incorporating multiple universal constraints. Following Kenstowicz (1996), he suggested that the language typically disallows unstressed

short high vowels in open syllables, and formulated this in the constraint *i]σ, introduced in the previous chapter and stated in (2).

(2). *i]σ: High short unstressed vowels are prohibited in open syllables (Kenstowicz, 1996).

The actual repair involves deleting the high vowel. However, since this constraint could also be satisfied by changing the vowel quality (lowering or backing), two additional markedness constraints were used, prohibiting the low vowel [a] and the high back vowel [u], as shown in

(3).

(3). *High Vowel Deletion*

/zi.'ra:ʃah/	*i]σ	No[u]	No[a]	*COM _{ONS}
a. zi.'ra:ʃah	*!			
☞ b. 'zra:ʃah				*
c. za.'ra:ʃah			*!	
d. zu.'ra:ʃah		*!		

This constraint ranking ensures that deleting the underlying /i/ is the only optimal solution. As a result, (b) is the preferred candidate, though it incurs a violation of low-ranked *COM_{ONS}.

Turning to vowel raising, the low short vowel /a/ is disfavored, so raising must occur. However, the output will not violate *i]σ since it is in a stressed syllable (see (4)).

(4). *Vowel Raising*

/katab/	*i]σ	No [u]	No [a]	*COM _{ONS}
a. 'ka.tab			*!	
☞ b. 'ki.tab				*
c. 'ku.tab		*!		

These tables show why a stressed short low vowel is disfavored and raising occurs as in (b) to satisfy No [a]. If the low vowel is raised to [u], however, it violates No [u] as in (c).

Therefore, candidate (b) is the optimal form.

While OT would appear sufficient to derive the examples above, the notion of unstressed vowels poses a potential problem. First, there are high vowels which undergo syncope on the surface, although they would bear stress had they not been deleted, as shown in example (5).

- (5). a. /git^saʕ/ → [gt^saʕ] ‘pieces’
 b. /birak/ → [brak] ‘dells’
 c. /ħufar/ → [ħfar] ‘holes’
 d. /ʃigag/ → [ʃgag] ‘apartments’
 e. /dʒuraf/ → [dʒraf] ‘cliffs’

Given that stress occurs on penultimate syllables in CVCVC words (as will be discussed in Chapter 5), the first vowel would be stressed had it not been deleted. Put differently, if these vowels were not deleted, they would not violate *i]σ, but the high vowel is deleted in these examples, which is problematic for this constraint. If stress is considered a factor in eliding the high vowel in open syllables, the forms in (5) show an overapplication of this process.

A related issue is that low vowels that undergo raising are not always stressed in Najdi dialects, as shown in (6).

- (6). a. /za'wa:dʒ/ → [zi.'wa:dʒ] ‘wedding’
 b. /sam:aħ/ → [si.'m:aħ] ‘forgiveness’
 c. /s^sa'ba:ħ/ → [s^si.'ba:ħ] ‘morning’
 d. /ʃab'a:b/ → [ʃi.'ba:b] ‘youth’
 e. /la'ja:li/ → [li.'ja:li] ‘nights’

If high vowels get deleted to avoid a constraint against unstressed high vowels in open syllables, why would low vowels surface as unstressed high vowels? This dissertation develops alternative analyses to address these questions.

3.2.2 Vowel Raising and High Vowel Deletion as Reduction in a Chain Shift

A different approach, using a version of OT called Sympathy Theory, was proposed by McCarthy (2003), building on earlier work in McCarthy (1993). For Bedouin Hijazi Arabic, McCarthy observed that vowel raising and low vowel deletion may result from a single vowel

shift rather than two rules working separately. To account for this shift, McCarthy developed a “scalar” analysis. The key feature of this analysis is vowel duration, where each non-long vowel in an open syllable must shift to a phonetically shorter vowel, along the scale [a] > [i], [u] > Ø.

Kirchner (1996) further developed the concept of a vowel chain shift. According to Kirchner, the shift is explained by a phonetic scale of vowel duration. Because high vowels are phonetically shorter than low vowels (Lehiste, 1970), a low vowel is reduced to a shorter one that is high; in turn, the high vowel is reduced to an even shorter vowel, which is deleted. This argument was based on the direction of vowel raising and high vowel deletion in Bedouin Hijazi Arabic and a three-step vowel shift in Nzebi, a Bantu language in Gabon. For Bedouin Hijazi Arabic, Kirchner came up with the constraint in (7).

(7). Reduce: The duration of a short vowel in open syllable must be minimized.

Kirchner (1996) explained the shift within OT by means of faithfulness. The logic for his argument was that if /A/ > B in context X and /B/ > C in the same context X, but /A/ never changes to C, then /A/ > C mapping is prohibited because it is less faithful than the other two mappings. Gnanadesikan (1997) also explained this type of behavior using faithfulness constraints to implement a chain shift, although she relied on phonological features like height and stricture. Given this background, McCarthy (2003), following Kirchner (1995, 1996), suggested that vowel raising and syncope processes like high vowel deletion in Bedouin Hijazi Arabic could be accounted for by using one constraint, Reduce. This constraint assigns one violation to high short vowels and two violations to low vowels, which enforces reduction on a scale of [a] > [i], [u] > Ø. This constraint is in direct opposition to two faithfulness constraints, as shown in (8) and (9).

- (8). STAY(S): “Input and output have the same position on the scale S.” (McCarthy, 2003, p. 42)
- (9). STAY-ADJ(S): “Input and output have the same or adjacent positions on the scale S.” (McCarthy, 2003, p. 42)

The crucial difference between the couple of constraints is that STAY(S) is violated by changing the vowel position on a scale (i.e., raising or syncope), whereas STAY-ADJ(S) is only violated by longer movements, i.e., [a] > syncope. In subsequent sections, I evaluate these constraints into an analysis of SNA vowel processes.

3.2.3 Directionality in Trisyllabic Elision

A major question concerning trisyllabic elision is how the deletion in a sequence of two light syllables is decided. In other words, why is the first vowel always deleted rather than the second? Few studies have sought to address this question. One OT analysis on trisyllabic elision by Al-Qahtani (2014) proposed that the rule was motivated by a restriction against three consecutive light syllables, as stated in (10).

- (10). *LLL: Assign one violation mark for a sequence of three light syllables. (p. 124)

This constraint rules out surface forms with three open syllables in a row under the assumption that final consonants are extrasyllabic; i.e., a final CVC is considered light. The problem is this constraint cannot specify which vowel is deleted to avoid three light syllables. For example, the underlying form /jadʒarah/ ‘tree’ could surface as [jɔdʒa.rah] or [*jadʒrah]. Thus, to rule out undesired outputs like [*jadʒrah], Al-Qahtani (2014) proposed that another constraint must be involved in the evaluation, Syllable Contact, as articulated in (11) and demonstrated in (12).

- (11). SYLLCON: “The onset of a syllable must be less sonorous than the last segment in the immediately preceding syllable, and the greater the slope in sonority the better.” (Bat-El, 1996, p. 302)

(12). SYLLCON

/fadʒarah /	*LLL	SYLLCON	MAX-IO	*COM _{ONS}
a. ʃa.dʒa.rah	*!			
☞ b. ʃdʒa.rah			*	*
c. ʃadʒ.rah		*!	*	

However, this analysis can be easily challenged by the fact that, in most instances, Najdi Arabic does not enforce the Syllable Contact Law. In fact, even if one argued that SYLLCON is only inviolable by any derived surface forms, the data in Najdi dialects (and possibly other Bedouin dialects like Bedouin Hijazi Arabic) does not appear to support such a claim, as shown in (13).

- (13). a. /kaðabat/ → [kði.bat] / *[kað.bat] ‘she lied’
b. /salagat/ → [sli.gat] / *[sal.gat] ‘she boiled’
c. /ħarakah/ → [ħri.kah] / *[ħar.kah] ‘motion’
d. /waladih/ → [wli.dih] / *[wal.dih] ‘his son’

The examples in (13) suggest that SYLLCON is not a factor in the analysis. If SYLLCON were driving the choice of which vowel to delete, one could predict output forms such as *[kað.bat]. In fact, a form such as [kði.bat] should be favored given that it does not contain open syllables, which are targeted by syncope.

Further complications arise when trisyllabic elision applies to words that cannot include three consecutive light syllables (LLL), such as [w.ri.gatk] ‘your paper’ derived form /waragat-k/. Here, the final syllable is heavy, even if the last consonant is extrasyllabic; therefore, the form does not contain three consecutive light syllables. Based on these observations, SYLLCON and *LLL might not be the correct constraints to analyze trisyllabic elision.

To account for the directionality of trisyllabic elision, McCarthy (2003) proposed that foot construction and stress patterns govern the environment for low vowel deletion. This deletion, according to McCarthy, is due to Bedouin Hijazi Arabic and most Bedouin dialects

having iambic stress. Thus, in a foot of two light moras, the second one must be stressed.

Meanwhile, the constraint GRPHARM requires the stressed vowel to be strengthened, as shown in (14).

(14). GRPHARM: “In an iambic foot (x ‘y), |y| > |x|.” (McCarthy, 2003, p. 38)

Motivated by foot well-formedness, the first unstressed vowel must undergo shortening (or deletion in this case) to strengthen the stressed vowel (McCarthy, 2003). As a result, the first underlying vowel is deleted after stress is assigned. One strategy to satisfy GRPHARM is to strengthen the stressed vowel by increasing its duration, while another is to weaken the unstressed vowel, which can lead to deleting that vowel. Given this rationale, GRPHARM has to be ranked higher than STAY-ADJ(S) and STAY(S), as illustrated in (15).

(15). GRPHARM

/katab-at/	GRPHARM	STAYADJ(Dur)	Reduce	STAY(Dur)
ا. (ktí).bat		*	*	**
b. (kití).bat	*!		**	**

Raising the two low vowels as in (b) violates the higher constraint GRPHARM, and this candidate is therefore eliminated. While this analysis generally makes correct predictions for Bedouin Hijazi Arabic, there are cases of vowel syncope that nevertheless cannot be explained by Reduce and GRPHARM alone. In some cases, if the underlying form has a sequence of two high vowels or a low vowel followed by a high vowel, the second vowel is always deleted, as in the passive forms shown in (16).

- (16). a. /(kiti)bat/ [kit.bat] / [*kti.bat] ‘it (f) was written’
 b. /(misi)kat/ [mis.kat] / [*msi.kat] ‘it (f) was caught’
 c. /sirig-at/ [sir.gat] / [*sri.gat] ‘it (f) was stolen’
 d. /nadʒis-ah/ [nadʒ.sah] / [*ndiʒ.sah] ‘filthy (f)’
 e. /galig-i:n/ [gal.gi:n] / [*gli.gi:n] ‘worried (plural)’
 f. /mihtarig-ah/ [miħ.tar.gah] / [*miħt.ri.gah] ‘burned (f)’

If GRPHARM forces a sequence of low vowels to strengthen the iambic syllable, the second in the foot, it should do so with a sequence of other vowels as well. If trisyllabic elision is regulated by stress patterns, it is hard to exclude other vowel sequences as in (16). While the dataset does not show trisyllabic elision, but rather high vowel deletion, one should expect syncope to be governed by GRPHARM as well. One might argue that the reason for deleting the second vowel in passive forms in (16a-c) is lexical distinctness or avoidance of homophony of the active verbs. Nevertheless, the rest of the examples still challenge the idea that stress or GRPHARM is responsible for the type or location of vowel deletion.

Another shortcoming of GRPHARM is that it does not exclude more transparent candidates like *[kat.bat] even in (15). This candidate is more faithful than the actual form [ktibat], which undergoes two changes (deletion and vowel quality change), rendering it opaque. To avoid this opaque structure, McCarthy (2003) suggested that within Sympathy Theory there is a key new constraint, SYM. This constraint selects one candidate, the sympathetic candidate, and then evaluates additional forms compared to this candidate. This ‘sympathetic candidate’ is selected by means of faithfulness to the input form; it is the most harmonic candidate relative to a designated faithfulness constraint; ‘the selector.’

McCarthy (2003) explained how the sympathetic candidate and faithfulness constraint (selector) are designated. On the one hand, choosing the selector is determined by the two (or possibly more) competitors. The faithfulness constraint that is violated by these competitors is chosen as the selector. For instance, the competition in (15) is between the actual candidate which is [(ktí).bat] and a potential transparent candidate, [(kát).bat]. In this scenario, STAYADJ(Dur) is the selector and should be marked with the symbol ★. Then, the most faithful candidate that is distinct from all competitors should be the sympathetic candidate.

Having established that, a sympathy constraint designated as *SYM evaluates all competing candidates with regard to the sympathetic candidate. This is shown (17).

(17). *Evaluating Candidates Based on Sympathy Constraint* (McCarthy 2003, p. 46)

/katab-at/	GRPHARM	*SYM	★ STAYADJ (Dur)	REDUCE	STAY (Dur)
Opaque a. (k.tí).bat		*	*		**
Sympathetic * b. (kití).bat	*!			**	**
Transparent c. (kát).bat		**!	*		*
Faithful d. (ka.tá).bat	*!			****	

The selector is STAYADJ(Dur) based on the violations by the two competitors (a) and (c). The sympathetic candidate is (b) because it is the most harmonic candidate that triggers fewer violations of Reduce than (d). Thus, the optimal form should have the most similarity to the sympathetic candidate. Here, candidate (a) is more similar to (b), which is shown by one violation mark as opposed to two violations for (c).

McCarthy (2003) pointed out that even though Sympathy Theory was initially proposed as a means of handling opacity, it can be generalized to non-opaque forms because *SYM can be satisfied by the optimal form. However, evaluation of SYM based on sympathy to a chosen intermediate form makes the function of EVAL very complex. Idsardi (1997) argued that Sympathy Theory leads to a chaotic grammar and fares no better than other OT approaches. Kiparsky (2000) similarly stated that Sympathy Theory has its limitations, particularly where a language has more opaque structures. Kiparsky suggested that each opaque form would need different sympathy constraints. Similar objections were reported by Itô and Mester (2003) in their analysis of German.

In addition to these concerns, I argue that the SYM constraint is not adequate even for the dialect of Bedouin Hijazi Arabic that McCarthy analyzed. For instance, a potential candidate like

*[kit.bat] should be as faithful to the sympathetic form [ki.ti.bat] as the actual word [kti.bat] ‘she wrote’

(18). *Inadequacy of SYM*

/katab-at/	GRPHARM	✿SYM	★ STAY ADJ(Dur)	Reduce	STAY (Dur)
☞ a. (k.tí).bat		*	*	*	**
✿ b. (kití).bat	*!			**	**
c. (kát).bat		*!*	*		*
d. (ka.tá).bat	*!			****	
☞ e. (kít).bat		*	*		**

The tableau shows three competitors rather than two: (a), (c), and (e). Given that they violate the same faithfulness constraint STAADJ(Dur), i.e., the selector, their mapping to the sympathetic candidate (b) can be troublesome. Since (a) and (e) show the same level of similarity to (b), it is not clear how the actual output (a) can be selected as the optimal form.

Another issue arises in cases with a feminine suffix, e.g., /katabatih/ > [ktibtih] ‘she wrote it.’ Therefore, the sympathy constraint might not always make the correct prediction in SNA.

Given the limitations of Sympathy Theory, an alternative approach is necessary.

3.2.4 Feminine Suffix Vowel Deletion

Another syncope, feminine suffix vowel deletion, targets the vowel in the feminine suffix -at when it occurs in an open syllable. The data suggest this vowel is not tolerated, regardless of its position in the word, as demonstrated in (19). Regardless of the position of the suffix, it undergoes syncope in an open syllable, as in examples (19a-e). In examples (19f-j), this vowel is in a closed syllable and remains.

- (19). a. /katab-at-ih/ [ktib.tih] ‘she wrote it’
 b. /maktab-at-i/ [mak.tib.ti] ‘my library’
 c. /rasam-at-ah/ [rsim.tih] ‘she drew it’
 d. /dʒarat-ih/ [dʒir.tih] ‘his tree’
 e. /warag-at-ih/ [wrig.tih] ‘his paper’

f. /katab-at-hum/	[kti.bat.hum]	‘she wrote them’
g. /rasam-at-na/	[rsi.mat.na]	‘she drew us’
h. /ʃadʒar-at-k/	[ʃdʒa.ratk]	‘your tree’
i. /warag-at-ha/	[wri.gat.ha]	‘her paper’
j. /maktab-at-hum/	[mak.ti.bat.hum]	‘their library’

Al-Mozainy (1981) first reported on this phenomenon, and more recent works have attempted to explain it. Al-Qahtani’s (2014) study of Najdi Arabic described it as a unique vowel deletion applied after heavy CVV syllables. He incorporated the constraint in (20) to eliminate such vowels in surface forms.

- (20). *CVV.CV]σ: An unstressed light penultimate syllable of the shape CV which follows a heavy antepenultimate syllable of the shape CVV is prohibited.

This phenomenon was also reported by Al-Solami (2020) in Ruwaili Arabic, a northern Najdi vernacular spoken by the Rulaili tribe. Al-Solami referred to it as a general process of low vowel deletion. However, in SNA, the syncope appears conditioned by the feminine suffix vowel, as shown in (21) and (22).

- | | | | |
|-------|-------------------|---------------|---------------|
| (21). | a. /ʃa:f-at-ih/ | [ʃa:f.tih] | ‘she saw it’ |
| | b. /ga:l-at-ih/ | [ga:l.tih] | ‘she said it’ |
| | c. /mo:t-at-ih/ | [mo:t.tih] | ‘his death’ |
| | d. /lo:h-at-i/ | [lo:h.ti] | ‘my painting’ |
| | e. /madras-at-ih/ | [mad.ris.tih] | ‘his school’ |
| | f. /maktab-at-ih/ | [mak.tib.tih] | ‘his library’ |
| | g. /warag-at-ih/ | [wrig.tih] | ‘his paper’ |
| | h. /ʃadʒar-at-ih/ | [ʃdʒir.tih] | ‘his tree’ |
-
- | | | | |
|-------|-----------------|---------------|----------------------|
| (22). | a. /madras-ah/ | [mad.ri.sah] | ‘school’ |
| | b. /maktab-ah/ | [mak.ti.bah] | ‘library’ |
| | c. /ʃallam-ih/ | [ʃal.li.mih] | ‘he told him’ |
| | d. /ʃa:rak-at/ | [ʃa:ri.kat] | ‘she participated’ |
| | e. /tʕa:lab-at/ | [tʕa:.li.bat] | ‘she demanded’ |
| | f. /ba:rak-o/ | [ba:.ri.ko] | ‘they congratulated’ |

The data in (21) show that low vowels are deleted only when they occur in the feminine suffix and do so regardless of the shape of the preceding syllable.⁶ Thus, for SNA, describing this syncope process as low vowel deletion or low vowel deletion after CVV syllables is not an adequate analysis. In contrast, both datasets suggest this low vowel deletion is restricted to the vowel in the feminine suffix -at. This claim is evident in (22) where other low vowels do not delete after CVC syllables, as in (22a-c), or CVV syllables, as in (22e-f). From a strictly phonological perspective, this is difficult to account for. While it is obvious that syllable structure plays a role, a stronger justification is required.

This section presented previous analyses of syllable patterns and relevant vowel processes in Bedouin Arabic dialects. While some accounts show promise for the analysis of SNA, such as reduction as a strategy for vowel raising and syncope, other accounts face unsolved issues. This dissertation seeks to explain these challenges in light of the data from SNA. The following section presents how SNA should be distinguished from Najdi Arabic more generally.

3.3 Vowel Processes in SNA

So far, I have outlined previous works on vowel processes in Bedouin dialects and weighed the strengths and weaknesses of each approach. In this section, I further investigate these challenges based on data from SNA. Vowel raising and high vowel deletion are handled in a rule-based model by two separate rules. Imposing a counterfeeding order produces the correct output, as shown in (23).

⁶ Al-Solami (2020) proposed that words like *maktibah* from *maktabah* are not subject to low vowel deletion due to stem-level foot parsing requirements and the final syllable being rendered extrametrical. However, in words like *maktbih* ‘his office,’ the low vowel is deleted since it is attached at the word level.

- (23). Rule (1) Trisyllabic elision: $a \rightarrow \emptyset / __ Ca\sigma$
 Rule (2) High vowel deletion: $i \rightarrow \emptyset / __ \sigma$
 Rule (3) Vowel raising: $a \rightarrow i / __ \sigma$ (Rule 1 and 2 must apply before 3)
 Rule (4) Feminine suffix vowel deletion: 3.f.s. $V \rightarrow \emptyset / __ tV [+Suffix]$

High vowel deletion and trisyllabic elision must both apply prior to vowel raising. If vowel raising occurs first, all underlying low vowels in open syllables are subject to high vowel deletion. Similarly, if vowel raising applies before trisyllabic elision, all sequences of low vowels become sequences of high vowels, which means trisyllabic elision is not applicable anymore. The problem in this relative ordering is when Rule 4 is incorporated in SNA.

One issue with a rule-based approach in SNA concerns the process of trisyllabic elision, which targets a sequence of low vowels. Why does the first vowel serve the target of the rule? In many examples, trisyllabic elision exhibits this one-sided directionality. However, as I mentioned earlier, in some Bedouin dialects including SNA, there are many forms in which the second vowel gets deleted rather than the first, particularly when feminine suffix vowel deletion is involved (Al-Mozainy, 1981), as shown in (24).

- | | | | |
|-------|-----------------|---------------|----------------|
| (24). | a. /katabatih/ | [k.tib.tih] | ‘she wrote it’ |
| | b. /rasamatih/ | [r.sim.tih] | ‘she drew it’ |
| | c. /maktabatih/ | [mak.ti.btih] | ‘his library’ |
| | d. /madrasati/ | [mad.ri.sti] | ‘my school’ |

In these examples, sometimes the first vowel is retained and the second one undergoes syncope, as in (24c-d). This is problematic for trisyllabic elision, which states that the first low vowel is deleted. Therefore, these forms require further explanation. One could argue that Rule 4 can be later in the derivation, but a real challenge would be to justify how feminine vowels are blocked from the application of trisyllabic elision. The same problem is encountered if Rule 4 occurs before trisyllabic elision. Under this scenario, one needs to justify the many examples where both trisyllabic elision and vowel raising occur in unpredicted environments, particularly

when both trisyllabic elision and vowel raising interact with feminine suffix vowel deletion.

Consider the ordering in (25).

(25). Underlying realization:	/katab-at-ih/	/madras-at-i/
Feminine suffix vowel deletion:	ka.tab.tih	madrasti
Trisyllabic elision/high vowel deletion:	<u> </u>	<u> </u>
Vowel raising:	kitabtih	<u> </u>
Surface realization:	[*kitabtih]	[*mad.ras.ti]

Unfortunately, this rule-based approach yields the wrong output forms in SNA. For the data in (24), it is not clear why words would undergo trisyllabic elision or vowel raising if feminine suffix vowel deletion applies before. Vowel raising only applies to low vowels in open syllables, yet all the examples show vowel raising in surface closed syllables. Such forms remain non-surface true even in a rule-based approach.

An alternative way of accounting for raising and syncope, as reported earlier, was vowel duration reduction. McCarthy (1993) observed in Bedouin Hijazi Arabic that these two processes could result from a single vowel shift rather than being a set of unrelated rules. Furthermore, Kirchner (1996) suggested that vowel raising and vowel deletion were usually related processes. These views have led to the theory of a vowel chain shift.

Following Kirchner and Gnanadesikan's (1997) framework, McCarthy (1999) adopted the constraint Reduce to account for the vowel processes in Bedouin Hijazi Arabic. Similarly, I adopt Kirchner and McCarthy's model for analyzing vowel raising, high vowel deletion, and trisyllabic elision in SNA. I demonstrate that a constraint-based approach (OT) better accounts for these changes by utilizing a language-specific ranking of cross-linguistic constraints. I propose that, rather than being counterexamples to trisyllabic elision, the examples in (24) arise due to interactions among competing constraints. I argue that morphological domains—that is, words, prefixes, and suffixes—facilitate this process. For example, it is important to observe that

deletion occurs when the morphological constituent of the feminine suffix is divided across two syllables rather than confined to a single syllable.

3.4 OT and Phonological Processes in SNA

This section lays out my analysis on SNA vowel processes encountered in this chapter within OT. In the first step, I introduce the motivation for vowel raising and high vowel deletion. I argue that the first two can be accounted for by one general motivation, namely vowel and syllable reduction. Next, I analyze trisyllabic elision. In doing so, I explore the motivation for the directionality in this deletion process. Then, I investigate feminine suffix vowel deletion and explain it with an alignment constraint. Lastly, I explain some issues with opaque patterns in SNA when processes interact.

3.4.1 Vowel Raising, High Vowel Deletion, and Trisyllabic Elision

Previous chapters presented the basic concepts of markedness and faithfulness constraints in OT. Additionally, I introduced the constraint Reduce. In this section, I use these constraints to analyze the vowel processes in SNA. Following Kirchner (1996) and McCarthy (1999, 2003), I propose that Reduce indicates a reduction in duration of a given vowel in the input. The function of this constraint is to assign any input of short vowels a violation unless they reduce in duration. This constraint interacts with two faithfulness constraints: the anti-deletion constraint MAX-IO and a constraint that enforces vowels to maintain their quality, IDENT-IO (V), as shown in (26).

(26). IDENT-IO (V): output vowels must be matched against input vowels (No change in vowel quality). (McCarthy & Prince, 1995)

While MAX-IO militates against any deletion of any input, including vowels, IDENT-IO (V) is violated only when there is a mismatch between the output vowel and its corresponding input vowel.

Ranking Reduce above these constraints makes it possible to derive the desired forms. In (27), I test examples of raising underlying low vowels. To ensure vowel raising is sufficient to satisfy Reduce, MAX-IO must outrank IDENT-IO (V). Otherwise, the deletion of an underlying low vowel would be possible: Reduce >> MAX-IO >> IDENT-IO (V).

(27). *Evaluation of [kitab] ‘He Wrote’*

/katab/	Reduce	MAX-IO	IDENT-IO (V)
a. ka.tab	*!		
b. ki.tab			*
c. ktab		*!	

The evaluation shows that (a) is ruled out, since the low vowel does not reduce. The last candidate (c) is also eliminated, since it violates the higher-ranked faithfulness constraint MAX-IO. As a result, candidate (b), which reduces the vowel /a/ to [i], is rendered the optimal candidate.

Similarly, the relative ranking of Reduce shows that high vowel deletion can be motivated by the same mechanism. However, high vowel deletion can lead to word-initial CC. As discussed in Chapter 2, complex onsets do occur in word-initial position in SNA surface forms; I argued that such onsets actually consist of a semisyllable C which is not affiliated with a syllable, followed by an onset C. Thus, from a structural point of view, complex onsets are not permissible in the language, enforced by the undominated constraint *COM_{ONS}. A sequence of semisyllable headless consonants violates the constraint Syl- μ . To satisfy Reduce for word-initial syncope, a consonant may be parsed under a semisyllable word-initially. To achieve this, the constraint Syl- μ must be dominated by Reduce and MAX-IO: *COM_{ONS} >> Reduce >> MAX-IO >> Syl- μ . With this ranking, (28) shows how the word [kta:b] ‘a book’ is analyzed.

(28). *Evaluation of [kta:b] ‘Book’*

/ki.ta:b/	*COM _{ONS}	Reduce	MAX-IO	Syl-μ
a. ki.ta:b		*!		
☞ b. k.ta:b			*	*
c. ka.ta:b		*!*		
d. kta:b	*!			

Only (b), with the initial syllable parsed as a semi-syllable, rather than a syllable onset, satisfies the high-ranking constraints Reduce and *COM_{ONS} and is therefore selected as the optimal candidate. Candidate (a) does not reduce and so is assigned a fatal violation. Candidate (c) is assigned two violation marks because it not only remains unreduced but also lengthens in duration. Candidate (d) parses a syllable with a complex onset, which triggers a fatal violation of *COM_{ONS}.

The constraint Reduce successfully predicts forms where so-called high vowel deletion and vowel raising are attested. Now I move on to more complicated examples with trisyllabic elision, involving complex surface forms where both deletion and raising are attested. The evaluation in (29) shows how a form like [kti.bat] ‘she wrote’ is derived.

(29). *Evaluation of [ktibat] ‘She Wrote’*

/ka.tab-at/	Reduce	MAX-IO	Syl-μ
☞ a. ki.ti.bat			
b. k.ta.bat	*!	*	*
☹ c. k.ti.bat		*!	*

The tableau does not succeed in producing the desired form (c). Because candidate (a) satisfies both Reduce and MAX-IO, it wins the competition. This means Reduce is not enough to derive the desired output, so there must be another constraint to make candidate (c) the optimal form. The dataset shows that trisyllabic elision applies when a vowel-initial suffix is attached to a preceding stem, e.g., [katab-at], suggesting an intolerance for a sequence of light syllables in non-final position.

The tendency of disfavoring light syllables in Arabic dialects is widely attested. Broselow (1992) reported light syllables were the least favored syllable type in many Arabic vernaculars (p. 32). In (29) above, the trend is not against light syllables in general but rather against a sequence of light syllables. McCarthy's (1981) analysis of Bedouin Hijazi Arabic formulated this trend in a rule that excludes surface forms with medial light syllables (p. 287). Based on these works, Zawaydeh & Davis (1996) suggested a constraint that disallows a sequence of light syllables in (30).

(30). *Light Light (*LL): A sequence of two light syllables is not permitted.

This constraint could be used by SNA to enforce syncope and rule out medial light syllables. It is worth noting that *LL is not exclusive to low vowels like trisyllabic elision. In principle, any sequence of two light syllables is not tolerated in SNA irrespective of the vowels' quality in this sequence. This generalization is presented in (31), in which candidate (a) is rendered optimal. Candidate (a) has a medial light syllable, violating *LL. Candidate (b), while avoiding a medial light syllable, causes a costly violation of Reduce.

(31). *Evaluation of [ktibat] 'She Wrote'*

/ka.tab-at/	Reduce	*LL	MAX-IO	Syl-μ
a. ki.ti.bat		*!		
b. k.ta.bat	*!		*	*
☞ c. k.ti.bat			*	*

Thus far, I have entertained the argument that Reduce is a constraint that handles both vowel raising and high vowel deletion, whereas *LL targets trisyllabic elision. However, the analysis does not predict the directionality of syllabification with trisyllabic elision, which targets a sequence of two low vowels in open syllables and deletes the first vowel: CaCa > CCa. An alternative repair for *LL would be to delete the second vowel: CaCa > CaC. Currently, the analysis does not distinguish between these alternatives, as shown in (32).

(32). *Evaluation of [ktibat] ‘She Wrote’*

/ka.tab-at/	Reduce	*LL	MAX-IO	Syl-μ
a. ki.ti.bat		*!		
b. k.ta.bat	*!		*	*
⊖ c. k.ti.bat			*	*!
☞ d. kat.bat			*	

If one syllable is reduced to satisfy the *LL constraint, then (d) is selected as the optimal output instead of the actual output (c). There appears to be a need for another constraint to govern trisyllabic elision since *LL does not prevent a surface form like *[kat.bat] in (d).

McCarthy suggested in Bedouin Hijazi Arabic that iambic stress was a factor in the directionality of trisyllabic elision and that GRPHRAM forced the first vowel to become reduced or deleted. Nonetheless, it is hard to rule out other types of vowel syncope like high vowel deletion in (33).

(33). a. /(kiti)bat/	[kit.bat] / *[k.ti.bat]	‘it (f) was written’
b. /(misi)kat/	[mis.kat] / *[m.si.kat]	‘it (f) was caught’
c. /sirig-at/	[sir.gat] / *[s.ri.gat]	‘it (f) was stolen’
d. /nadʒis-ah/	[nadʒ.sah] / *[n.dʒi.sah]	‘filthy (f)’
e. /galig-i:n/	[gal.gi:n] / *[g.li.gi:n]	‘worried (plural)’
f. /mihtarig-ah/	[miħ.tar.gah] / *[miħt.ri.gah]	‘burned (f)’

Alternatively, syncope in trisyllabic elision might be justified by the simple markedness constraint *COD. Even a relatively low ranking of this constraint gives preference to CCV over a competitor *CVC. This constraint must also outrank Syl-μ: *COD >> Syl-μ (see (34)).

(34). *Evaluation of [ktibat] ‘She Wrote’*

/ka.tab-at/	Reduce	*LL	MAX-IO	*COD	Syl-μ
a. ki.ti.bat		*!	*		
b. k.ta.bat	*!		*	*	*
☞ c. k.ti.bat			*	*	
d. kat.bat			*	*!*	

In this tableau, candidate (a) is ruled out as predicted by *LL, which disallows two adjacent light syllables. Similarly, candidate (b) is eliminated even though it satisfies *LL,

because it violates a high-ranked constraint, Reduce. Thus, the competition is between the remaining candidates (c) and (d). Candidate (d), however, has two closed syllables, which results in two violation marks of *COD. Consequently, (c) is selected as the optimal candidate.

*LL ranking is crucial for all types of syncope in SNA. Some SNA forms exhibit a pattern in which the second vowel gets deleted rather than the first, as in (33). Although the examples in (33) are not in the domain of trisyllabic elision (a sequence of two low vowels), they show that GRPHARM is not responsible for vowel syncope and that *LL can be relevant for all types of vowels. However, *LL must be lower than Reduce, resulting in different patterns for different vowels. The word [nadʒsah], for instance, shows why the pattern is reversed. In (35), satisfying *LL alone does not render the form optimal since it has a more fatal violation of Reduce. Thus, form (b) is the optimal candidate.

(35). *Evaluation of [nadʒsah] ‘Filthy (f)’*

/nadʒis-ah/	Reduce	*LL	MAX-IO
a. na.dʒi.sah	*!*	*	
b. nadʒ.sah			*
c. n.dʒi.sah	*!		*

This section provided a more economical analysis of two phonological processes: high vowel deletion and vowel raising. The model shows that both processes are motivated by one pattern, duration reduction on a scale of [a] > [i], [u] > Ø. This was shown by incorporating the constraint Reduce. For trisyllabic elision, I proposed that sequences of non-final light syllables are prohibited in SNA, enforced by *LL. To determine which vowel is deleted in the sequence, a universal markedness constraint (*COD) was proposed that prefers open syllables.

3.4.2 Morphological Alignment

So far, I have introduced the set of constraints necessary to account for high vowel deletion, vowel raising, and trisyllabic elision in SNA. However, one group of exceptions to

trissyllabic elision occurs in a sequence of underlying low vowels where the second vowel undergoes syncope. This pattern was shown to apply only when the feminine suffix vowel is deleted in open syllables, as in [mak.tib.tih] from [mak.ta.ba.tih] ‘his school.’

To account for this behavior, I propose that each part of a given morpheme must be aligned within the edges of a prosodic constituent. Prince and Smolensky (1993) initially proposed such constraints under the family of the general alignment constraint, shown in (36).

- (36). ALIGN (L/R): The edge of a morphological constituent coincides with the edge of a syllable (where L, R denote left and right) (p. 114)

The basic assumption is that ALIGN governs the relationship “between prosody and grammatical structure” (p. 114). Of particular interest to the current analysis is one constraint that aligns stems with the right edge of a syllable suggested by McCarthy and Prince (1993a):

- (37). ALIGN (Stem, R, σ , R): Align the right edge of a stem with the right edge of a syllable.

What this constraint means is the edges of each stem have to be aligned with the right edge of a syllable. McCarthy and Prince (1993) found some languages kept a stem right-edge aligned with a syllable, such as the Australian language Lardil. Lardil has a word minimality condition that requires each word to be disyllabic (Wilkinson, 1988). Therefore, monosyllabic stems have vowel epenthesis. However, instead of vowel epenthesis, there seems to be an “excessive epenthesis” of consonant-plus-vowel strings, as shown in (38).

- | | | | | |
|-------|-----------|-----------|----------|-----------------------------|
| (38). | a. /mar/ | [mar.ta] | ‘hand’ | |
| | b. /ril/ | [ril.ta] | ‘neck’ | |
| | c. /kaŋ/ | [kaŋ.ka] | ‘speech’ | |
| | d. /tʰaŋ/ | [tʰaŋ.ka] | ‘some’ | (Itô & Mester, 1994, p. 39) |

To account for this “excessive epenthesis,” McCarthy and Prince (1993) suggested the stem alignment constraints, which ensure that the right syllable edge coincides with the morpheme edge. Otherwise, the vowel should suffice to satisfy the word minimality condition.

Following McCarthy and Prince (1993), I propose that SNA data satisfy a right-edge alignment constraint. This constraint is satisfied by means of syncope in feminine suffix vowel deletion. This constraint should be restricted to the root rather than the whole stem:

- (39). ALIGN (Root, R, σ , R) (AL-R-R): Align the right edge of a C consonantal root with the right edge of a syllable.

Thus, whenever the segmental content of one morpheme crosses a syllable boundary, this triggers a violation of AL-R-R. This constraint should be ranked above both MAX-IO and *COD. Otherwise, syncope of the feminine suffix vowel cannot apply, because the regular pattern of trisyllabic elision would be maintained. To make the morphological boundaries distinct from syllable boundaries, I use square brackets for morphemes and conventional dots for syllable boundaries.

- (40). *Evaluation of [maktibtih] 'His Office'*

/maktab-at-ih	Reduce	*LL	AL-R-R	MAX-IO	*COD
a. [mak.ti.b]a.tih	*!	*	*		**
b. [mak.tib.]tih				*	***
c. [makt.b]i.[t]ih			*!	*	**
d. [mak.ti.b]i.t]ih		*!	*	*	**

In this tableau, form (a) is ruled out immediately due to a fatal violation of Reduce. Candidate (d) also incurs a fatal violation of *LL by allowing two light syllables to surface. The competition between (b) and (d) depends on satisfying AL-R-R. The square brackets show the boundary between the root and suffixes, just as the hyphens do in /maktib-at-ih/. If the right edge of the root does not coincide with the right edge of a syllable, the form receives one violation mark. Candidate (b) satisfies this alignment constraint by deleting the vowel of the feminine suffix. Candidate (c), however, shows a misalignment as the feminine suffix is divided between two syllables, which incurs a violation of AL-R-R. As a result, candidate (b) is the optimal form.

I now turn to different syllable types with feminine suffix vowel deletion, which applies even after heavy CVV syllables in SNA, as shown in Table 38. The forms (b) and (c) satisfy the most dominant constraint (Reduce) as well as *LL. However, candidate (b) incurs fewer violations of AL-R-R and therefore is selected as the optimal candidate.

The ALIGN-R-R constraint adequately addresses the question of why the vowel in the feminine suffix -at is deleted in open syllables. Note, however, that SNA also has cases in which this vowel is not deleted even when it occurs in an open syllable, as in (42).

(41). *Evaluation of [ʃa:ftih] ‘She Saw Him’*

/ʃa:f-at-ih/	Reduce	*LL	AL-R-R	MAX-IO	*COD
a. [ʃa:f]a.tih	*!		*		*
☞ b. [ʃa:f.]tih				*	**
c. [ʃa:f]i.tih			*!*		**

- (42). a. /kʊrf-at-ih/ [kʊr.fi.tih] ‘his bedroom’
 b. /χibr-at-ih/ [χib.ri.tih] ‘his experience’
 c. /farʃ-at-i/ [far.ʃi.ti/] ‘my carpet’
 d. /badal-at-i/ [bad.li.ti] ‘my suit’

What distinguishes these words from the rest is that the outcome of deletion would lead to clusters of three consonants. This is not surprising given that cross-linguistically syncope is often blocked by the presence of a certain number or type of consonants (Taylor, 1994). Hence, I argue that such words with CCC clusters would violate a higher-ranked constraint if syncope was applied. Such a constraint was introduced by Prince and Smolensky (1993) in (43).

- (43). *COMPLEX_{CODA} (*COM_{COD}): A syllable must not contain more than a single coda segment.

This constraint should be ranked above AL-R-R but below Reduce, a ranking that appears to solve the problem (see 44). Thus, a hypothetical form like candidate (d) is ruled out because it violates the constraint *COM_{COD}. As a result, candidate (b) is selected as optimal, even though it has more violation marks for the lower constraint AL-R-R.

(44). *Evaluation of [ʁurfɪtɪh] ‘His Room’*

/ʁurf-at-ih/	Reduce	*LL	*COM _{COD}	AL-R-R	MAX-IO	*COD
a. [[[ʁur.f]a.t][ih]	*!			**		**
☞ b. [[[ʁur.f]i.t][ih]				**		**
c. [[[ʁurf].t][ih]			*!	*	*	**

The issue with this analysis is that, as we have seen, complex codas are actually permitted in SNA and most Bedouin dialects. Complex codas exist in some underlying forms and are allowed to surface, e.g., in [bint] ‘girl’ and [katabt] ‘I wrote.’ Additionally, a complex coda cluster may emerge word-medially due to syncope, e.g., [jakt.bu:n] ‘they write.’ However, such forms are derived by a different motivation, Reduce. Different motivations lead to different outcomes. Thus, I need to show *COM_{COD} can be violated as shown in (45) to satisfy a higher-ranked constraint such as Reduce. Note that the introduction of *COM_{COD} did not influence the analysis of the correct output (b). Therefore, *COM_{COD} is a violable constraint.

(45). *Evaluation of [jaktbu:n] ‘They Write’*

/jaktub-u:n/	Reduce	*LL	*COM _{COD}	AL-R-R	MAX-IO	*COD
a. [jak.tu.b]u:n]	*!			***		**
☞ b. [jakt.b]u:n]			*	***	*	**

This section explained feminine suffix vowel deletion in SNA through a morphological constraint that forces roots to be aligned to the right edge of a syllable. When exceptions surface, this constraint is violated due to a higher constraint that prohibits complex codas. The following section investigates more troublesome cases when these processes interact.

3.4.3 More Problematic Cases in SNA

In SNA, several cases pose problems for OT analysis, particularly when two (or more) processes are applicable in these forms. This phenomenon is always attested when multiple affixes are attached to a word, as shown in (46).

- (46). a. /katab-at-ih/ [ktib.tih] ‘she wrote it’
 b. /rasam-at-ih/ [rsim.tih] ‘she drew it’
 c. /maktab-at-ih/ [maktib.tih] ‘his library’
 d. /madras-at-i/ [madris.ti] ‘my school’

What is striking in these examples is that low vowels raise even in closed syllables. Table 41 shows how a surface word [ktibtih] ‘she wrote it’ is derived. The problem in tableau (47) is the actual surface form is (c), but candidate (b) is selected as the winner. Before obtaining output selected as optimal, I need to figure out why a vowel is raised even if it falls in a closed syllable. One could suggest the constraint Reduce enforces raising for any underlying low vowel in an open syllable, but this assumption is not ideal. First, OT is a surface output model. Second, this would mean that syllabication must take place in the underlying form. Third and most importantly, this would lead to many problematic exceptions. Many words with underlying low vowels in open syllables do not get raised or deleted, e.g., /nadʒisah/ > [nadʒsah]/*[nidʒsah] ‘filthy (f).’

(47). *Evaluation for [ktibtih] ‘She Wrote It’*

/katab-at-ih/	Reduce	*LL	*COM _{COD}	AL-R-R	MAX-IO
a. [[[ki.ti.b]a.t]ih]	*!	*		**	
☞ b. [[[ki.tab.]t]ih]				*	*
☹ c. [[[ktib.]t]ih]				*	*!*
d. [[[kti.b]i.t]ih]		*!		**	*

To understand the obstacle of such non-surface-true forms, I must establish that vowel raising driven by Reduce applies at some level prior to the syncope of the feminine suffix vowel. In other words, I need one evaluation where Reduce is applicable, as in /katabat/ > [ki.ti.bat], then another where the previous output becomes a new input, i.e., /kitibat-ih/ > /kti.ba.tih/. Otherwise, the framework cannot hold. However, modeling such a serial mapping in Classical or Parallel OT is impossible.

An alternative approach, Stratal OT, consists of several mappings that are serially ordered. The model is schemed in Figure 13. Since Stratal OT is built on lexical phonology, the level at which each affix is attached is crucial for understanding a derivation. As noted earlier, Kiparsky (2000, 2003) suggested that subject suffixes in Arabic attach at the stem level, whereas object and possessive suffixes attach at the word level. Rakhieh (2009) reported that Ma'ani Arabic followed that model.

Drawing on these proposals, I hypothesize that SNA has subject agreement affixes at the stem level, as shown in (48), whereas object agreement affixes and possessive pronouns are attached at the word level, as in (49) and (50), respectively.

(48).	Subject suffix	Suffix	Word
	-∅	masak	'he held'
	-at	masak-at	'she held'
	-aw	masak-aw	'they held'
	-t	masak-t	'I held'
	-na	masak-na	'we held'
	-t	masak-t	'you held'
	-tu	masak-tu	'you (plural) held'
(49).	Object suffix	Suffix	Word
	-ih	[[msik-at] _{stem} -ih] _{word}	'she held him'
	-ha	[[misak-t] _{stem} -ha] _{word}	'you held her?'
	-hum	[[misak-na:] _{stem} -hum] _{word}	'we held them'
	-ni	[[msik-aw] _{stem} -ni] _{word}	'they held me'
	-na	[[misak-tu:] _{stem} -na] _{word}	'you (plural) transferred us'
	-k	[[msik-at] _{stem} -k] _{word}	'she held you'
	-ts	[[misak] _{stem} -ts] _{word} ⁷	'he held you (f)'
	-kum	[[misak-t] _{stem} -kum] _{word}	'I held you (plural)'

⁷ The status of the second-person feminine object suffix is not straightforward. While it is believed to be originally /ki/, there is palatalization as the suffix is realized as the interdental affricate /ts/ (see Johnstone, 1963).

(50). Possessive suffix	Suffix	Word
-ih	[[walad] _{stem} -ih] _{word}	‘his son’
-ha	[[walad] _{stem} -ha] _{word}	‘her son’
-hum	[[walad] _{stem} -hum] _{word}	‘their son’
-i	[[walad] _{stem} -i] _{word}	‘my son’
-na	[[walad] _{stem} -na] _{word}	‘our son’
-k	[[walad] _{stem} -k] _{word}	‘your son’
-ts	[[walad] _{stem} -ts] _{word}	‘your (f) son’
-kum	[[walad] _{stem} -kum] _{word}	‘your (plural) son’

The morphological concatenation takes place at different levels depending on the morphemes. Note that in (49), the stem forms are different from (48) because phonology has already been applied at the stem level. A schematic representation is shown in Figure 13, from Kiparsky (2003) and Rakhieh (2009).

Figure 13

Morphological Concatenation

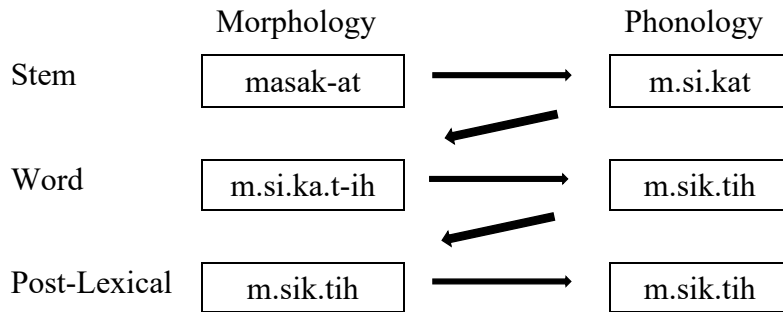
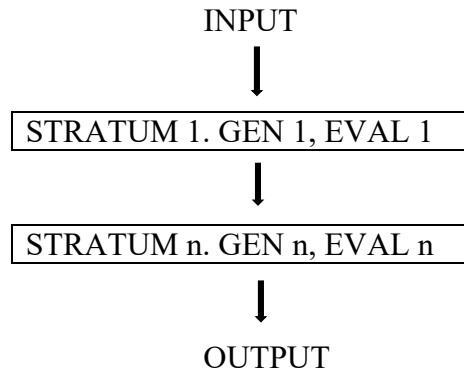


Figure 13 shows the output of the first level can be the input of the next. As Kiparsky (2000, 2003) explained, the first level serves as the stem level, and its output becomes the input of the following level, i.e., the word level. Analogously, the output of the word level becomes the input of the post-lexical level. In Stratal OT, this can be achieved by serial input-output mappings, as shown in Figure 14, taken from Kager (1999a, p. 382).

Figure 14

Stratal OT



The concepts of serially ordered evaluation can be captured by generating multiple strata, which are schematized in (51-52), each representing a level of phonology. Tables 42–44 reveal two crucial points. First, the hierarchy of constraints at one stratum can be distinct from that of another. Second, the outcome of rearranging this hierarchy could result in an intermediate candidate, i.e., forms distinct from both the underlying form and the actual output, which is shown by CAN B. In a parallel approach, CAN B can never be achieved.

(51). *Stem Level*

Input: X	CON 1	CON 2	CON 3
☞ CAN A			*
CAN B		*!	
CAN C	*!		

(52). *Word Level*

Input: CAN A	CON 3	CON 1	CON 2
CAN A	*!		
☞ CAN B			*
CAN C		*!	

(53). *Post-Lexical Level*

Input: CAN B	CON 3	CON 2	CON 1
CAN A	*!		
CAN B		*!	
☞ CAN C			*

Given this configuration, it is possible to re-examine the examples in (46). Starting at the stem level, I begin with the constraints established so far. In Chapter 1, I suggested trisyllabic elision and vowel raising were applicable at the stem level, so I start with the established ranking in (54), as analyzed in Table (55).

(54). Constraint hierarchy at the stem level: ONS, *COM_{ONS} >> Reduce >> *LL >> MAX-IO >> *COD >> Syl- μ , IDENT-IO (V)

(55). *Stem-Level Evaluation of [ktibih] ‘She Wrote It’*

/katab-at/	Reduce	*LL	MAX-IO	*COD	Syl- μ	IDENT-IO (V)
a. ka.ta.bat	*!*	*		*		
☞ b. k.ti.bat			*	*	*	*
c. ki.ti.bat		*!		*		**
d. kat.bat			*	*!*		

In the first level, the top-ranked constraints are Reduce and *LL. To satisfy Reduce, the first two vowels should change to /i/, whereas *LL prohibits a sequence of two light syllables. With the interaction of *COD, candidate (b) emerges as optimal because it has no coda, whereas (d) has a coda.

When object suffixes attach to the verb stem, they trigger a new domain of phonology, the word level. At that level, the constraint ranking changes. Here, AL-R-R and *COM_{COD} become part of the analysis, even though they did not play a role at the stem level, as in (56).

(56). Constraint hierarchy at the word level: ONS, *COM_{ONS} >> Reduce >> *LL >> *COM_{COD} >> AL-R-R >> MAX-IO >> *COD >> Syl- μ , IDENT-IO (V)

The feminine suffix vowel is not deleted unless it occurs in an open syllable. For this reason, I do not expect this morpheme to appear in open syllables at the stem level given that -at would be closed, as no further affix is attached yet (see (57)).

(57). *Word-Level Evaluation of [ktibtih] ‘She Wrote It’*

/ktibat-ih/	Reduce	*LL	*COM _{COD}	AL-R-R	MAX-IO	*COD
a. k.ti.ba.tih	!*	*		*		*
b. k.ti.bi.tih	*!	*		*	*	*
☞ c. k.tib.tih					*	**

The input here is an intermediate form, the output of the stem level, /ktibatih/. This and the addition of different constraints at the word level produce (c) as the optimal output. In Classical OT, it would be impossible to understand why an underlying low vowel /a/ raises in a closed syllable. For the post-lexical level, I can assume for now the hierarchy has not changed. This claim is revisited in Chapter 6. For a post-lexical assessment, see (58).

(58). *Post-Lexical Evaluation of [ktibtih] ‘She Wrote It’*

/ktibtih/	Reduce	*LL	*COM _{COD}	AL-R-R	DEP-IO	MAX-IO	*COD
☞ a. ktib.tih							*
b. kti.bi.tih	*!	*		*	*	*	*
c. ki.tib.tih					*!	*	**

At the third level, the input-output mapping has reached a convergence point, where there is no further change (McCarthy, 2000b).⁸ Inserting a vowel violates top-ranked *LL and Reduce, as in candidate (b), or violates the faithfulness constraint DEP-IO, as in (b) and (c).

While this ranking produces the desired output, it is still not quite correct. Vowel raising and high vowel deletion are motivated by Reduce, which drives a reduction on the scale [a] > [i],

⁸ The term convergence was used by McCarthy (2000b) in a different serial model, Harmonic Serialism. However, the technical meaning is the same.

[u] > Ø. If so, it is unclear whether raised low vowels at the stem level should also be vulnerable to syncope, since they are now high vowels. As the data show, this turns out not to be the case. For instance, the word /madrasah/ ‘school’ is realized as [madrisah] ‘school.’ If Reduce applies at the stem level, /madrasah/ > [mad.ri.sah], and then at the word level, I would expect /mad.ris.sah/ to delete the high vowel to satisfy Reduce at the word level, leading to a form like [*madr.sah]. Thus, I propose the constraint Reduce must be delegated to a lower ranking at the word level. Indeed, one of the strengths of Stratal OT is the ability to re-rank constraints at different strata of the grammar. This would allow raised vowels at the stem level to remain at the word level. Otherwise, in order to satisfy Reduce again, these vowels would need to be deleted, producing an incorrect outcome. This new ranking is given in (59).

(59). Word constraint hierarchy, revised: ONS, *COM_{ONS} >> *LL >> *COM_{COD} >> AL-R-R >> MAX-IO, DEP-IO >> Reduce >> *COD >> Syl-μ, IDENT-IO (V)

I test this proposal by walking through the tableaux at each level. For a simple vowel raising example, the derivation is apparent in (60).

(60). *Stem-Level Evaluation of [maktibah] ‘Library’*

/maktab-ah/	Reduce	*LL	MAX-IO	*COD
a. mak.ta.bah	!*			**
☞ b. mak.ti.bah				**
c. makt.bah			*!	**

As the evaluation shows, maintaining a low vowel in an open syllable as in (a) incurs a fatal violation of Reduce. Deleting the low vowel, as in (c), incurs a fatal violation of MAX-IO. However, candidate (b) raises the low vowel to [i], satisfying both Reduce and Max-IO.

At the word level, shown in (61), the correct ranking of *COM_{COD} and Reduce is crucial for selecting the optimal form. Candidate (a) is ruled out, since the high vowel of the input is lowered, which violates Reduce. However, deleting the high vowel in (c) is also fatal, since it

causes a violation of higher constraint *COMPLEX_{COD}. If Reduce maintained the high ranking that it occupied at the word level, (a) would be the incorrect winner in this evaluation. Note that at the post lexical level, there is no change expected, so there is no need to repeat the same mapping.

(61). *World-Level Evaluation of [maktibah] ‘Library’*

/maktibah/	*LL	*COM _{COD}	AL-R-R	MAX-IO	Reduce	*COD
a. mak.ta.bah					*!*	**
☞ b. mak.ti.bah					*	**
c. makt.bah		*!		*		**

Now I analyze the same stem with other morphemes attached at the word level. Keeping the same stem input, /mak.tibah/ ‘library,’ and adding the possessive suffix shows that the constraints *LL and *COM_{COD} are still needed at the top of the hierarchy (see (62)). As expected, any form with the feminine suffix vowel in an open syllable is eliminated, as in (a), (b), and (d). Consequently, (c) is selected as the optimal form.

(62). *Word-Level Evaluation of [maktibtih] ‘His Library’*

/maktibat-ih/	*LL	*COM _{COD}	AL-R-R	MAX-IO	Reduce	*COD
a. mak.ti.ba.tih	*!		*		**	**
b. makt.bi.tih		*!	*	*		**
☞ c. mak.tib.tih				*		***
d. mak.ti.bi.tih	*!		*		*	

The previous example showed the necessity for a serial model, where Reduce must apply before AL-R-R. Otherwise, in Parallel OT, one would expect [mak.tab.tih] to be the winner. The same reasoning is relevant in forms where AL-R-R is violated, as the feminine suffix vowel is deleted in every word even when it occurs in an open syllable (see (63)).

(63). *Stem-Level Evaluation of [ka:tbitih] ‘His Female Writer’*

/ka:tib-ah/	Reduce	*LL	MAX-IO	*COD
a. ka:ti.bah	!*			*
☞ b. ka:t.bah			*	**

At the first stage, the output of the stem level is [ka:t.bah]. In this mapping, the high vowel must be deleted to avoid a Reduce violation. Therefore, (b) is the winner. Now /ka:t.bah/ must be the input for the word level when the suffix -ih is attached in (64).

(64). *Word-Level Evaluation of [ka:tbitih] ‘His Female Writer’*

/ka:t.bat-ih/	*LL	*COM _{COD}	AL-R-R	MAX-IO	DEP-IO	Reduce	*COD
a. ka:tibatih	*!		*		*	*	*
b. ka:t.batih			*	*		*	**
☞ c. ka:t.bitih			*	*			**

The example in (46) shows why the actual output (c) is selected as the winner; the high vowel /i/ must have been deleted at an earlier stage at the stem level. Then, the feminine suffix deletion followed. In a parallel mapping for an input of /ka:ti-bat-ih/, the non-surface-true output would be *[ka:tib.tih], where both Reduce and AL-R-R are satisfied. Stratal OT thus does a better job of correctly predicting such opaque structures.

The constraint AL-R-R can be violated when outranked by higher constraints; in particular, this occurs to avoid CCC clusters. As noted before, AL-R-R is dominated by *COM_{COD}: at the word level only and not at the stem level. The evaluation in (65) shows how this works for the stem [ʁurfah] ‘room.’

(65). *Stem-Level Evaluation of [ʁurfatih] ‘His Room’*

/ʁurf-ah/	ONS *COM _{NOS}	Reduce	*LL
☞ a. ʁur.fah			
b. ʁu.rfah	*! COM _{NOS}		
c. ʁurf.ah	*! ONS		

Here, no input-output change occurs at the stem level, and the underlying stem serves as the input for the word level. Next, at the word level, where the possessive suffix attaches, the tableau in (66) shows the proposed postulation.

(66). *Word-Level Evaluation of [ʁurfatih] ‘His Room’*

/ʁurfat-ih/	*LL	*COM _{COD}	AL-R-R	MAX-IO	Reduce	*COD
a. ʁur.fɑ.tih			*		*!	**
b. ʁurf.tih		*!		*		**
☞ c. ʁur.fi.tih			*			**

As in earlier tableaux, deleting the feminine suffix vowel is not an option, since it incurs a violation of the higher constraint *COM_{COD}, as in (b). As a result, the competition is between candidates (a) and (c). Since (c) satisfies the now lower-ranked Reduce, it is the winner.

Next, I analyze another form in (67), where the feminine suffix vowel is deleted, but complex codas do not play a role in the evaluation.

(67). *Stem-Level Evaluation of [ʃa:ftih] ‘She Saw Him’*

/ʃa:f-at/	Reduce	*LL	MAX-IO	*COD	IDENT-IO (V)
☞ a. ʃa:.fat				*	
b. ʃa.fat				*	*!

At the stem level, the top-ranked constraints do not enforce syncope or a change in quality of any vowel, so the output is faithfully mapped to the input. The evaluation for /ʃa:f-at-ih/ shows that feminine suffix vowel syncope occurs, because the complex coda constraint plays no role for this form. See (68) below.

(68). *Word-Level Evaluation of [ʃa:ftih] ‘She Saw Him’*

/ʃa:fat-ih/	*LL	*COM _{COD}	AL-R-R	MAX-IO	Reduce	*COD
a. ʃa:.fa.tih			*!*		*	*
b. ʃa:.fi.tih			*!*			*
☞ c. ʃa:f.tih			*	*		**

Next, I show how the relative ranking of *COM_{COD} is crucial at the word level. As shown earlier, this constraint can be violable, particularly when Reduce is ranked higher than it, a ranking which now arguably is in force at the stem level. This was shown in (45), repeated in (69).

(69). *Stem-Level Evaluation of [jaktubu:n] ‘They Write’*

/jaktub-u:n/	Reduce	*LL	MAX-IO	*COD
a. [[ja[k.tu.b]]u:n]	*!			**
☞ b. [[ja[kt.b]u:n]			*	**

The question is how to satisfy *COM_{COD} at the word level if it is ranked higher and Reduce is demoted to a lower level. The same question holds for cases where complex coda clusters appear due to affixation, as shown in the previous chapter. Such affixation would take place at the word level. To account for any possible vowel insertion, a constraint that militates against epenthesis is necessary to avoid undesired forms. One such constraint has been introduced earlier in DEP-IO. To rule out undesired forms with epenthesis, DEP-IO must be ranked higher than *COM_{COD}. A revised word-level constraint hierarchy is given in (70) and illustrated in (71).

(70). Word constraint hierarchy, revised: ONS, *COM_{ONS} >> *LL, DEP-IO >> *COM_{COD}>> AL-R-R >> MAX-IO >> Reduce >> *COD

At the word level, the input, which is the output of the stem level, is mapped to two possible candidates. To avoid a violation of COMP_{COD}, candidate (b) inserts a vowel. However, this repair is ruled out due to a fatal violation of higher-ranked DEP-IO. Therefore, candidate (a) is selected as the winner in this evaluation.

(71). *Word-Level Evaluation of [jaktubu:n] ‘They Write’*

/jaktbu:n/	DEP-IO	*COM _{COD}	AL-R-R	MAX-IO	Reduce	*COD
a. [[jak.tu.bu:n]	*!				*	**
☞ b. [[jakt.b]u:n]		*	*	*		**

The role of this constraint is crucial at the stem level. Reduce is top-ranked at the stem level and relatively lower-ranked at the word level. The relative ranking of Reduce, DEP-IO, and *COMP_{COD} at different levels helps understand why similar words like *[jaktbih] from /jaktub-ih/ are not permissible. The evaluation in (72) shows how this works.

(72). *Stem-Level Evaluation of [jaktubih] ‘He Writes It’*

/jaktub/	Reduce	*LL	DEP-IO	*COD
☞ a. jak.tub				**
b. ja.ku.tub	*!		*!	*

At the stem level, the faithful candidate does not violate Reduce, so the mapping selects (a) as the output. The word level input, which is still equivalent to the underlying form, is mapped to the most faithful candidate. In other words, no high vowel deletion takes place, even though Reduce is violated. In contrast, satisfying Reduce incurs a now higher constraint, *COM_{COD}, as in (b) in (73).

(73). *Word-Level Evaluation of [jaktubih] ‘He Writes It’*

/jaktubih/	DEP-IO	*LL	*COM _{COD}	AL-R-R	MAX-IO	Reduce	*COD
☞ a. jak.tu.bih				*		*	**
b. jakt.bih			*!	*	*		**
c. ja.kut.bih	*!						

The need for the anti-epenthesis constraint is crucial for underlying CVCC stems plus suffixes, for instance, /bint-hum/ ‘their daughter’ and /be:t-ha/ ‘her house.’ Possessive suffixes do not attach at the stem level. Therefore, the relative ranking of Contiguity can rule out internal epenthesis at the word level. Tableaux in (74) and (75) show the evaluation after the stem level.

(74). *Word-Level Evaluation of [bint.hum] ‘Their Daughter’*

/bint-hum/	DEP-IO	*LL	*COM _{COD}	AL-R-R	Reduce	*COD
☞ a. bint.hum			*			**
b. bin.ti.hum	*!			*	*	**
c. bi.nit.hum	*!				*	**

(75). *Word-Level Evaluation of [be:t.ha] ‘Her House’*

/be:t-ha/	DEP-IO	*LL	*COM _{COD}	AL-R-R	Reduce	*COD
☞ a. be:t.ha						**
b. be:.ti.ha	*!			*	*	*

The tableaux show that candidate in (a) is selected as the optimal form, even though it violates COMP_{COD}. A similar pattern is observed for CVVC syllables where complex codas are not an issue. These evaluations show again that Contiguity correctly rules out epenthesis in cases where complex codas are at stake and in cases where they are not.

As we have seen, the interaction of multiple processes often leads to opacity, which Stratal OT can overcome. Instances where vowel raising and high vowel deletion seem to overlap can be analyzed with serial tableaux that are motivated by the morphological structure of the word and by ranking Reduce is only ranked highly at the stem level. This analysis also explains why the feminine vowel suffix sometimes fails to be deleted, since the constraints enforcing it essentially occur too late, at the word level.

3.5 Conclusion

This chapter addressed certain vowel processes that take place in most Bedouin dialects, particularly Nadji dialects. The first half of the chapter highlighted challenges with linear and constraint-based approaches. In light of the data from SNA, I argued in favor of a scalar vowel reduction of [a] > [i], [u] > ∅ for high vowel deletion and vowel raising. With respect to trisyllabic elision, I proposed a markedness constraint that prohibits sequences of light syllables, and for the directionality of syncope I proposed the well-formedness constraint *COD.

Additionally, the analysis supported the existence of one syncope process, feminine vowel suffix deletion, proposed by Al-Mozainy (1981).

I analyzed these phenomena following an OT approach and showed that each could be captured by universal constraints. While Classical or Parallel OT can handle most phenomena in SNA, several opaque structures posed a challenge. To overcome these problems, I utilized a slightly different version of OT, Stratal OT, in which morphological and phonological processes interact at different levels. Under Stratal OT, I attributed the non-surface-true forms to intermediate input-output mappings. The first evaluation takes place at the stem level, and the output of this evaluation becomes the new input at the word level. Chapter 6 analyzes additional opaque structures at the post-lexical level.

Chapter 4: Guttural Metathesis

4.1 Introduction

The previous chapter analyzed four phonological processes: vowel raising, high vowel deletion, trisyllabic elision, and feminine suffix vowel deletion. This chapter addresses an additional process at the lexical (stem and word) level: guttural metathesis. Najdi Arabic appears to show metathesis between /a/ and a following adjacent guttural consonant, such as /taχrab/ → [t.χa.rab] ‘go bad.’ Although metathesis is well attested in natural languages and has received considerable attention in the literature, notably by Hume (2001), metathesis remains a poorly motivated phenomenon in phonology. For example, one of the common arguments in favor of a metathesis analysis is that it makes structures within a language more uniform, more salient, and phonologically less marked (Canfield, 2015; Grammont, 1950; Hock, 1985; Hume 1991, 1998, 2001; Ultan, 1978). However, these goals could typically be accomplished by more common and phonologically natural processes, such as epenthesis or deletion. Furthermore, previous researchers (notably Blevins & Garrett, 2004) have argued convincingly that synchronic metathesis such as [taχrab] ~ [t.χa.rab] would be best analyzed as a result of two separate changes—vowel epenthesis and vowel deletion, or vice versa—with each change taking place at one point in historical time. Based on these observations, it is appropriate for linguists to ask whether metathesis is a real phonological concept.

In this chapter, I argue that the data in SNA support the idea that metathesis is the outcome of two distinct processes: epenthesis of [a] and deletion of underlying /a/. In other words, the surface form [t.χa.rab] is the product of two ordered processes. In the first process, epenthesis occurs, /taχrab/ → [ta.χa.rab]. Subsequently, a deletion process applies, which is trisyllabic elision: [ta.χa.rab] → [t.χa.rab]. The principal argument I use for such an approach,

laid out in Section 4.2., is that epenthesis and deletion occur independently of one another in SNA. That is, epenthesis of [a] after guttural consonants occurs in many forms where deletion does not occur. Similarly, trisyllabic elision takes place almost freely in many forms where epenthesis does not take place. These facts necessitate a complete reanalysis of guttural metathesis in SNA.

An issue with this reanalysis is why /a/ carries a special status. Although I argue that epenthesis and deletion are independent of one another, it nevertheless remains the case that both processes target /a/ to the exclusion of other vowels, an important fact that must be accounted for. As I demonstrate in Section 4.3, the special status of /a/ is due to its featural similarities with guttural consonants. Thus, any vowel inserted next to a guttural consonant is likely to acquire its features via local spreading. With respect to deletion, however, /a/ next to a guttural consonant is subject to deletion due to the general rule that targets medial light syllables.

After laying the groundwork for a new analysis of SNA guttural metathesis, I turn to analyzing the data in Najdi Arabic with a constraint-based approach. In Section 4.4, I sketch an analysis within traditional or “Parallel” OT. I address the issue of vowel quality, particularly the special status of /a/ within a constraint-based framework. In this regard, I show that the exceptional behavior of /a/ can be explained in OT by means of coordinated constraints (Hume, 2001), two constraints that are joined such that one constraint is only violated when both constraints are independently violated.

4.2 Statement of the Problem

CV metathesis has been widely discussed in the literature of Arabic dialects by Abboud (1979), Ingham (1994), Zawaydeh (1999), Blevins and Garrett (2004), and Al-Solami (2013). Guttural metathesis has been reported to switch any sounds of the group /χ, ʁ, ħ, ʕ, h/ with a

preceding low vowel /a/ whenever the sequence is followed by a consonant. For convenience, the examples are repeated in (1).

- | | | | | |
|------|----|-----------|-----------|------------|
| (1). | a. | /taχrab/ | [tχarab] | ‘go bad’ |
| | b. | /naħsib/ | [nħasib] | ‘we count’ |
| | c. | /gahwah/ | [ghawah] | ‘coffee’ |
| | d. | /maʕru:f/ | [mʕaru:f] | ‘known’ |
| | e. | /maʕsu:l/ | [mʕasu:l] | ‘washed’ |

Al-Solami (2013) and Zawaydeh (1999) provided an acoustic analysis of metathesis triggered by non-emphatic gutturals in the coda of non-final syllables. Zawaydeh (1999), working on Negev Bedouin Arabic, attributed guttural metathesis to the observation that non-final syllable gutturals are not tolerated in the coda. Therefore, re-syllabification is required, e.g., /CVG.CV/ (where G stands for a guttural) → [CV.GV.CV].

Al-Mozainy (1982) reported this metathesis in Bedouin Hijazi Arabic, a dialect closely related to Najdi Arabic, where the underlying form /CVG.CV/ surfaces as [CGV.CV]. Although Al-Mozainy described the phenomenon as a “metathesis,” he admitted that some exceptions, like the first-person singular verbs, only exhibit insertion, as in (2).

- | | | | | |
|------|----|----------|-------------|-----------|
| (2). | a. | /ʔaħsib/ | [ʔa.ħa.sib] | ‘I count’ |
| | b. | /ʔaʕrif/ | [ʔa.ʕa.rif] | ‘I know’ |
| | c. | /ʔaʕsil/ | [ʔa.ʕa.sil] | ‘I wash’ |

Al-Qahtani (2014) used an OT perspective to take a different approach to guttural metathesis. According to his analysis, guttural metathesis creates initial biconsonantal clusters regardless of the SSP of the output cluster. Both initial consonants that violate the SSP, such as /gh-/ , /nχ-/ , /nħ-/ , or /jʕ-/ , and those that conform, such as /tʕ-/ , are found in Najdi Arabic.

However, the motivation for metathesis, according to his analysis, is to avoid rising sonority across a syllable boundary, i.e., the Syllable Contact Law. However, if syllable contact was the

trigger for guttural metathesis, then words with preconsonantal gutturals would not be expected to metathesize even when syllable contact requirements were met, as in (3).

- (3). a. /maʕdu:l/ [m.ʕadu:l] ‘amended’
 b. /maxtu:n/ [m.xa.tu:n] ‘circumcised’
 c. /jaħkum/ [j.ħa.kum] ‘he rules’
 d. /taxbiz/ [t.xa.biz] ‘she bakes’

The fact that the underlying forms show a guttural preceding a consonant with either a lower or the same sonority is problematic for the argument that guttural metathesis is motivated by the Syllable Contact Law. Clearly, these words still surface with a reordered CV output. Hence, there has to be another explanation for the derivation of non-emphatic guttural metathesis in Najdi Arabic.

An alternative view refers to metathesis as a two-stage process (Abboud, 1979; Blevins & Garrett, 2004). Abboud’s (1979) analysis of verb formation in Northern Najdi Arabic was a pioneering work on guttural metathesis. His description of the phenomenon favored epenthesis of a low vowel after the guttural, which he called post-guttural low vowel insertion. In rule-based phonology, the rule could be stipulated as one of the following in (4).

(4). Rule: Post Guttural Epenthesis

/GC/ → [GaC] / a _

or alternatively

∅ → a / aG _ C

The application of this rule feeds another rule, trisyllabic elision, as in (5).

(5). Rule: Trisyllabic Elision: CV.CV → CCV

Trisyllabic elision targets all derived words that surface with a sequence of light syllables, as shown in (6). Trisyllabic elision is not restricted to guttural environments but occurs with any vowel in a sequence of medial light syllables.

- (6).
- | | | |
|-----------------|--------------|----------------------|
| a. /katab-at/ | [k.ti.bat] | ‘she wrote’ |
| b. /katab-t-um/ | [ki.tab.tum] | ‘you (plural) wrote’ |
| c. /katab-aw/ | [k.ti.baw] | ‘they wrote’ |
| d. /katab-na/ | [ki.tab.na] | ‘we wrote’ |

Blevins and Garrett (1998) argued that CV metathesis in most Bedouin Arabic dialects is the output of two historical processes, which they called pseudometathesis; i.e., epenthesis followed by deletion (p. 523). In their view, synchronic guttural metathesis originated from two independently motivated processes. First, the historical change of epenthesis occurred, followed later by a deletion change. This sequence is what Blevins and Garrett identified as the “common source of pseudometathesis” (p. 523). The argument that synchronic metathesis is preferably attributed to diachronic changes was summarized by Blevins and Garrett (2004):

Our view is that diachronic regularities play a major role in determining phonological typology. Since actual phonological systems have evolved diachronically, their properties reflect constraints on sound change as well as constraints on the nature of phonological systems. Explanations for phonological patterns may reside in synchronic analysis or diachronic evolution. Which explanation will emerge in any case is a matter to be resolved based on the evidence, but since historical accounts permit simpler grammatical models, they are preferable wherever possible. (p. 118)

In describing guttural metathesis, however, there are still some important gaps to fill. First, as mentioned before, the fact that guttural metathesis only takes place after an underlying low vowel /a/ deserves further attention. Guttural metathesis is not attested if a guttural is preceded by high vowels /i/ or /u/. Furthermore, epenthesis of /a/ occurs independently of deletion in order to repair word-final guttural consonant clusters, as in (7).

- (7).
- | | | |
|------------|-----------|-----------|
| a. /baxt/ | [ba.xat] | ‘fortune’ |
| b. /qaħtʕ/ | [ga.ħatʕ] | ‘drought’ |
| c. /baʕd/ | [ba.ʕad] | ‘after’ |
| d. /fahd/ | [fa.had] | ‘cheetah’ |

Examples in (7) show that /a/ epenthesis applies after a guttural, even when metathesis does not occur. To the best of my knowledge, no prior work has associated so-called metathesis

to post-guttural epenthesis. Further data in SNA show that post guttural epenthesis can occur independently with no deletion, as in (8).

- (8). a. /ʔaħsib/ [ʔa.ħa.sib] ‘I count’
 b. /ʔaʕrif/ [ʔa.ʕa.rif] ‘I know’
 c. /ʔaʕsil/ [ʔa.ʕa.sil] ‘I wash’
 d. /ʔahrub/ [ʔa.ha.rub] ‘I run’

In these examples, no synchronic metathesis is observed, yet a low vowel /a/ is still inserted. If the metathesis approach was the correct analysis, the examples in (7) would be unrelated forms that exhibited post-guttural epenthesis, or they would be exceptions to the metathesis rule. I argue, however, that the forms in (7) and (8) are closely linked to the so-called metathesized forms in (1) precisely because they reflect the independent application of low-vowel epenthesis. Following Abboud (1979) and Blevins and Garrett’s (2004) proposals, examples such as those in (1) are derived in (9).

- (9). a. /taχrab/ [ta.χa.rab] [t.χa.rab] ‘go bad’
 b. /naħsib/ [na.ħa.sib] [n.ħa.sib] ‘we count’
 c. /gahwah/ [ga.ha.wah] [g.ha.wah] ‘coffee’
 d. /maʕru:f/ [ma.ʕa.ru:f] [m.ʕa.ru:f] ‘known’
 e. /maʕsu:l/ [ma.ʕa.su:l] [m.ʕa.su:l] ‘washed’

Under this view, each surface word in (9) must have an intermediate stage, in which post-guttural /a/ epenthesis has occurred but vowel deletion has not yet occurred. This proposed epenthesis is limited to /a/ and to cases where a guttural is preceded by an underlying /a/ and followed by another consonant. Subsequently, the intermediate forms trigger another phonological process, vowel deletion (syncope). This syncope is motivated by a general process in SNA, trisyllabic elision, which disfavors a sequence of light syllables in word-medial position, */CaGCVC/ > */CaGaCVC/ > [CGaCVC]. This proposal is explained in the sections below.

4.3 Metathesis vs Epenthesis Approaches

The previous section highlighted issues facing the metathesis approach and discussed studies that tackled guttural metathesis in Najdi Arabic and other dialects. It then argued for an alternative epenthesis+deletion analysis. This section lays the groundwork for my approach. First, I discuss the relationship between gutturals and low vowels and how gutturals in general impact adjacent vowels in a variety of Arabic and Semitic dialects. Then, I show that post-guttural epenthesis is common in other Arabic and Semitic dialects. Lastly, I illustrate the basic differences between a metathesis approach and an epenthesis+deletion approach (pseudometathesis) and suggest which analysis provides a better explanation for the data in SNA.

4.3.1 Gutturals and Low Vowels

In general, guttural sounds are marked and relatively less frequent in languages. Gutturals (and pharyngeals in particular) are often involved in many phonological processes, such as vowel lowering and vowel epenthesis. McCarthy and Keating (1994) stated that one of the most salient properties of gutturals is their preference to appear next to low vowels. Hayward and Hayward (1989) also noted gutturals were typically associated with low vowels or phonological processes involving vowel lowering (and sometimes both, as in Najdi Arabic). Post-guttural epenthesis is not restricted to Najdi Arabic. Other Arabic dialects and Semitic languages behave in a similar fashion. In this section, I discuss the relationship between gutturals and low vowels, particularly general processes that show vowel lowering triggered by gutturals.

Vowel lowering due to adjacent guttural sounds is not uncommon, particularly in Semitic languages. Interestingly, this effect appears to be bidirectional in most cases. In Tiberian Hebrew, for instance, there is a general epenthesis rule that breaks up final consonant clusters (CC#), e.g., [malk] > [melek] ‘king.’ The default vowel for epenthesis seems to be /e/, and there

is also a rule for vowel assimilation that targets the original vowel. Nevertheless, when the epenthetic vowel is preceded or followed by a guttural consonant, it surfaces as [a], e.g., [balʕ] > [belaʕ] ‘swallowing,’ [baʕl] > [baʕal] ‘master.’

In Syrian Arabic, the feminine forms of nouns are realized by attaching a vowel suffix /e/ or /a/ to the stem (a masculine noun). This type of allomorphy depends on the last stem consonant. The vowel /e/ seems to be the default, as it appears after most consonants. However, if the last consonant is a guttural, the suffix is realized as a low /a/, as in (10).

- (10). a. daraʒ-e ‘step’ d. wa:ʒh-a ‘display’
 b. ʃerk-e ‘society’ e. mniḥ:-a ‘good’
 c. madras-e ‘school’ f. dagga:ʕ-a ‘tanning’ (Cowell, 1964)

In Modern Standard Arabic, there is a vowel ablaut rule that applies to the second vowel forming the corresponding aspect (imperfective verbs). It is triggered by elision of the first vowel when the form is prefixed by [ja], CV₁CV₂C > ja-CCV₂C, as in (11).

- (11). Perfective Imperfective
 a. katab ‘he wrote’ yaktub
 b. makaθ ‘he stayed’ jamkuθ
 c. saraq ‘he stole’ yasriq
 d. kaʃaf ‘he revealed’ jakʃif
 e. ʃarib ‘he drank’ jaʃrab
 f. qabil ‘he accepted’ yagbal
 g. ʕalim ‘he knew’ yaʕlam
 h. rakib ‘he rode’ jarkab

Brame (1970) accounted for ablaut with a rule that included all the verbs of Class A and B (Class C verbs do not undergo ablaut, as the underlying vowel in the perfective is /u/ and remains unchanged in the imperfective forms). This is illustrated in (12).

Nonetheless, there are exceptions to this pattern. Many of them, as Brame (1970) stated, are words that have the second or third stem consonant as a “laryngeal” (the term that Brame used for gutturals). Specifically, the second vowel does not undergo the ablaut rule if it is a low

Ingham (1994) reported that gutturals in general appeared to have a special effect on vowel quality and syllable structure, as they blocked the vowel raising rule and metathesized in codas. Alsager (2020), in a phonetic study, reported that guttural consonants in Saudi Arabian dialect seem to have extreme influence on adjacent low vowels when compared to nonguttural consonants in the same environment.

- (14). a. ʕaraf / *ʔiraf, ‘he knew’
 b. xadam / *xidam ‘he served’
 c. haḏzam / * haḏzam ‘he attacks’
 d. ḥalaf / *ḥalaf ‘he took an oath’
 e. ʕasʕab / *ʕasʕab ‘he forced’

There is sufficient evidence from a variety of dialects for a special relationship between /a/ and gutturals, suggesting they share a crucial feature designation. Thus, although in Najdi Arabic it may seem a coincidence that two independent processes of epenthesis and deletion both refer to /a/, there is a logical explanation for this behavior if epenthesis is viewed as a progressive spreading of the feature [+guttural] from the guttural consonant to the epenthetic vowel. Then, deletion could be seen as satisfying another requirement prohibiting medial light syllables.

4.3.2 Post-Guttural Epenthesis in Other Languages

This section investigates evidence from other dialects and languages where gutturals tend to condition the epenthesis of a following /a/ in the same environment. One modern Arabic dialect that shows such behavior is the Negev Bedouin dialect, reported by Blanc (1970). This process is similar to what occurs in Najdi Arabic, as it only applies if a low vowel precedes the guttural, as in (15).

- (15). a. /maḥḏʕauub/ [ma.ḥa.ḏʕauub] ‘veiled’
 b. /maʕguul/ [ma.ʕa.guul] ‘reasonable’
 c. /jaḥlam/ [ja.ḥa.lam] ‘he dreams’
 d. /jaḥfir/ [ja.ḥa.fir] ‘he digs’
 e. /jaʕgil/ [ja.ʕa.gil] ‘he tethers’

In Modern Hebrew, a similar low vowel epenthesis rule is attested after a guttural. Pariente (2010) reported that in Sephardic Modern Hebrew, the pharyngeal fricatives /ħ, ʕ/ trigger vowel epenthesis in addition to vowel lowering, as in (16). This process is summarized in the rule in (17) by Montoya (2014).

- (16). a. /goʔlim/ [goʔalim] ‘they redeem’
 b. /maʕmad/ [maʕamad] ‘status’

- (17). Rule: Post-guttural a-epenthesis: $\emptyset \rightarrow a / G_C$, a is inserted between a guttural and a following consonant

These processes show that a guttural triggering epenthesis is by no means exclusive to Najdi Arabic. Rather, guttural consonants prefer an adjacent low vowel /a/, whether by lowering an existing vowel or inserting one.

4.3.3 Metathesis vs. Pseudometathesis

A problem that undermines the concept of metathesis in phonological theory is that it is less frequent than other sound changes, such as assimilation, deletion, and epenthesis. Metathesis appears under-motivated and is often viewed as a sporadic phonological process. According to Hume (2001), most theoretical frameworks lack clear explanations describing metathesis. On the other hand, analyses that treat synchronic metathesis as epenthesis and deletion, or vice versa, are justified by the naturalness of each individual sound change. Furthermore, each of these changes is independent in its application. In light of these facts, if the data in Najdi Arabic supports the idea that each change operates independently, which seems to be the case here, a two-stage process would be preferred.

Blevins and Garrett (1998) concurred that metathesis has been problematic in phonological theory. They showed two major types of problems that arise in phonological analysis, namely that “metathesis has resisted analysis in terms of phonetically natural or

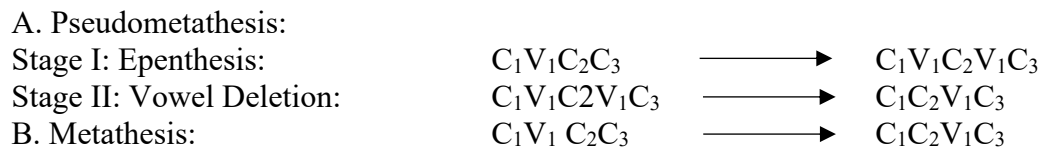
motivated sound change, and the reordering of sounds in metathesis has required extensions of otherwise highly restrictive phonological formalisms” (p.117).

Several proposals have assumed metathesis to be the result of successive phonological processes such as deletion and epenthesis (Besnier, 1987; Hume, 1991), spreading of a single feature (Rice, 1992), segregation (McCarthy, 1989), template maximization (Van der Hulst & Engelenhoven, 1994), and vowel epenthesis to degenerate syllables (Lyche, 1995). In the Rotuman language, for instance, Besnier (1987) concluded that diachronic processes like epenthesis and deletion resulted in synchronic metathesis. Balangao metathesis was also represented as deletion followed by epenthesis (Shetler, 1976). Schuhardt (1866) and Behrens (1888) provided similar explanations for synchronic Romance metathesis. These sound changes are described in the literature as pseudometathesis (Blevins & Garrett, 1998; Mills et al, 1980).

The difference between metathesis and pseudometathesis is shown in Figure 15.

Figure 15

Difference between Metathesis and Pseudometathesis (cited from Blevins & Garrett, 1998)



Note that the numerals next to vowels and consonants are orders from left to right, yet the epenthetic vowel carries the same numeral as the preceding vowel since it is a copying process rather than a mere epenthesis (I discuss this process in detail below).

According to Hume (1998), one of the functions of metathesis is to enhance the perceptual salience of certain segments, such as pharyngeal fricatives, by placing them in onset position. This argument holds weight insofar as sounds in general are more salient in the onset

(Fujimura et al., 1978; Redford & Diehl, 1999; Steriade, 2001; Wright, 2001). However, vowel epenthesis could lead to the same result, namely syllabifying less salient segments in the onset.

One of many reasons why epenthesis-deletion approaches are superior to metathesis approaches is that vowel epenthesis and deletion are phonological changes that can be seen to operate independently in the language and are said to be “phonetically natural.” Metathesis, on the other hand, is relatively less regular and more limited in its scope (Hume, 1998). A second crucial reason for favoring epenthesis and deletion over metathesis is that words with an apparent CV metathesis often have dialectally related forms where vowel epenthesis occurs without deletion. This turns out to be true with Najdi Arabic guttural metathesis. First, in many words, vowel epenthesis applies after a guttural, even if there is no apparent metathesis on the surface forms. Second, in SNA, vowel deletion or trisyllabic elision appears to apply across the board. Hence, it is plausible to think that words with metathesized surface forms may instead be a combination of these two processes at once.

Another factor that renders some cases of CV or VC reordering as cases of pseudometathesis is the scope of its application. In many languages, the sounds associated with CV metathesis include the whole inventory of consonants and vowels, as in Rotuman or Kwara’ae (Takahashi, 2018). However, in most attested synchronic metathesis cases, the process is said to be highly restricted as it pertains to a handful of segments, in this case gutturals and low vowels.

I follow the view that guttural metathesis in Najdi Arabic is pseudometathesis, a combination of epenthesis and deletion. Thus, seemingly metathesized forms are the product of a series of changes. Evidence from SNA and related dialects support this view.

4.4 Analyzing Guttural Pseudometathesis in OT

Previous sections discussed guttural metathesis and presented challenges to metathesis approaches. I argued in favor of an alternative pseudometathesis approach, which involves a two-process phenomenon rather than a synchronic reordering of segments. In this section, I begin an analysis of this phenomenon within OT.

4.4.1 Epenthesis Plus Deletion

This section gives a tentative analysis of guttural pseudometathesis in SNA via OT and shows how this approach is ultimately inadequate. With Najdi Arabic guttural pseudometathesis, I first introduce the constraints used in the analysis, starting with the basic faithfulness constraints MAX-IO and DEP-IO. To account for trisyllabic elision, *LL (no sequence of light syllables) was stipulated as a top-ranked constraint. Since MAX-IO is violable in SNA, its ranking has to be relatively lower than *LL as shown in the previous chapter: *LL >> MAX-IO. Furthermore, I have stipulated that epenthesis is militated against by a highly-ranked constraint DEP-IO: DEP-IO, *LL >> MAX-IO, DEP-IO. To ensure the phenomenon is not metathesis, I need a faithfulness constraint that penalizes the reversal of segment order in the output. This constraint is Linearity: “ S_1 is consistent with the precedence structure of S_2 , and vice versa (No Metathesis)” (McCarthy & Prince, 1995, p. 123). In other words, when a segment S_1 precedes another segment S_2 in the input, that order must be preserved in the corresponding output.

Finally, I need a constraint that triggers epenthesis after a guttural. In other words, the restriction against the structure /aGC/ should be expressed in OT terms. I assume for now a markedness constraint *aGC that prohibits a sequence of /aGC/. This constraint must be undominated by the aforementioned constraints. Otherwise, there would be many gutturals in such positions. With respect to Linearity, I argue this constraint is also high in ranking, but the

order between Linearity and *aGC is not crucial for this analysis. I justify below why this ranking is correct: *aGC, Linearity >> *LL, DEP >> MAX-IO.

Given these constraints, I attempt the derivation for some of the words in (1). With /gahwah/ ‘coffee,’ for example, I can sketch out the derivation in (18) based on the constraints introduced so far.

(18). *Evaluation of [ghawah] ‘Coffee’*

/ga _j hwah/	*aGC	Linearity	*LL	DEP-IO	MAX-IO
☞ a. g.ha _k .wah				*	*
b. ga _j h.wah	*!				
c. ga _j .ha _k .wah			*!	*	
d. g.ha _j .wah*		*!			

While candidate (a) results from epenthesis and deletion, candidate (d) is derived by switching the order of the guttural and the following vowel. Candidate (b) is immediately ruled out due to a violation of the undominated *aGC. Candidate (c) also incurs a fatal violation of *LL in addition to the faithfulness constraint *DEP-IO, whereas (d) violates a high-ranking constraint Linearity. Therefore, candidate (a) is the winner, even though it violates two lower-ranked constraints.

Note that in the tableau, (a) and (d) are identical on the surface but derived by different mechanisms. Candidate (a) surfaces by inserting a low vowel after the guttural and deleting the underlying low vowel to avoid *LL. In contrast, (d) swaps the guttural with the preceding low vowel. This distinction is shown by the subscript indexes next to all low vowels in the underlying and surface forms.

This is a basic analysis of guttural metathesis in OT, but it does not rule out the alternative view. In other words, pseudometathesis might simply be a case of metathesis rather than a complex derivation that involves both epenthesis and deletion. Linearity has to be ranked

above the rest of the constraints, though I did not justify this choice. Perhaps the Linearity constraint is ranked lower, such that swapping the guttural with the preceding low /a/ would satisfy the undominated *aGC constraint. While this derivation would lead to the desired surface form [ghawah], I argue this is not the correct analysis. To derive the desired output, the Linearity constraint would have to be ranked below the other faithfulness constraints. Otherwise, violation of both epenthesis and deletion could do the job. The tableau in (19) shows how this derivation works.

(19). *Evaluation of [ghawah] ‘Coffee’*

/ga _i hwah/	*aGC	*LL	DEP-IO	MAX-IO	Linearity
a. ga _i hwah	*!				
^{EXP} b. g.ha _i .wah					*
c. ga _i .ha _k .wah		*!	*		
d. g.ha _j .wah		*!	*		

Candidates (a) and (c) are ruled out due to fatal violations of the most dominant constraints, *aGC and *LL, respectively. Since candidate (b) violates the low-ranked constraint Linearity, it is the winner in this tableau.

While this derivation would lead to the desired surface form [g.ha.wah], there are basic issues with it. First, there is nothing in the ranking that could eliminate unattested forms such as [*gaw.hah] if metathesis could be used to avoid marked forms. As a matter of fact, the status of Linearity has been controversial and produces empirical problems by over-generating unattested forms (Canfield, 2015; Carpenter, 2002; Heinz, 2005), as shown in (20).

At this point in the derivation, there is no optimal form to proceed to the following step. In (20) it is shown that candidates (b) and (c) are equivalent in satisfying the higher constraints and each violates the lower faithfulness constraint Linearity, yet only form (b) is the actual word in the language. If linearity is this low, then form (c) is problematic for this approach.

(20). *Evaluation of [ghawah] ‘Coffee’*

/ga _j hwah/	*aGC	*LL	DEP-IO	MAX-IO	Linearity
a. ga _j h.wah	*!				
☞ b. g.ha _j .wah					*
☞ c. ga _j w.hah					*
d. ga _j .ha _k .wah		*!	*		

A second issue with the alternative approach is that there are many words where epenthesis appears necessary in a similar environment, though no apparent metathesis occurs, as in (7), repeated in (21) for convenience.

- (21). a. /baxt/ [ba.xat] ‘fortune’
 b. /qaħtʕ/ [ga.ħatʕ] ‘drought’
 c. /baʕd/ [ba.ʕad] ‘after’
 d. /fahd/ [fa.had] ‘cheetah’

One might argue this kind of epenthesis cannot be exclusively attributed to gutturals but rather to complex codas in words with CVCC syllables. While there is a common epenthesis process that applies to CVCC syllables in SNA, this rule is restricted to certain types of words, namely those that violate the SSP, as shown in (22).

- (22). a. /ħukm/ [ħu.kum] ‘decision’
 b. /faħm/ [fa.ħam] ‘coal’
 c. /ʔism/ [ʔi.sim] ‘name’
 d. /ʃakl/ [ʃa.kil] ‘shape’
 e. /ʃahr/ [ʃa.har] ‘month’
 f. /rakl/ [ra.kil] ‘kicking’
- g. /bint/ [bint] ‘girl’
 h. /ʃams/ [ʃams] ‘sand’
 i. /ʕanz/ [ʕanz] ‘goat’
 j. /ʔarb/ [ʔarb] ‘west’
 k. /bard/ [bard] ‘cold’

Epenthesis here is triggered whenever the consonant clusters have a rising sonority pattern in the underlying forms, as in (22a-f), whereas consonant clusters can surface word-finally as long as they follow the SSP, as in (22f-k).

In light of these facts, post-guttural /a/ epenthesis in (22) is different, given that all of the examples are in accordance with the SSP. Another piece of evidence supporting the distinction between word-final and post-guttural epenthesis is the behavior of each process when a vowel-initial suffix is added to each word, as shown in (23).

(23).	a. /ħukm/	[ħu.kum]	‘ruling’	/ħukm+ih/	[ħuk.mih]	‘his ruling’
	b. /ʔism/	[ʔi.sim]	‘name’	/ʔism+ih/	[ʔis.mih]	‘his name’
	c. /ʃakl/	[ʃa.kil]	‘shape’	/ʃakl+i/	[ʃa.kil]	‘my shape’
	d. /baʃd/	[ba.ʃad]	‘after’	/baʃd+i/	[b.ʃadi]	‘after me’
	e. /taħt/	[ta.ħat]	‘below’	/taħt+ih/	[tħa.tih]	‘below him’
	f. /saʃd/	[sa.ʃad]	‘fortune’	/saʃd+i/	[sʃa.di]	‘my fortune’

In (20a-c), when a suffix starting with a vowel attaches to the stem, a re-syllabification of the last stem consonant occurs. Thus, the epenthetic vowel is no longer needed. In (23d-f), a different behavior is observed; the post-guttural epenthetic vowel always surfaces in the output, regardless of the shape of the word. Consequently, this epenthesis must be exclusive to gutturals and is triggered by the marked form /aGC/.

4.4.2 Further Challenges for the Metathesis Approach

The previous section described how metathesis in SNA is better analyzed by means of an epenthesis-deletion process from an OT perspective. This section presents more challenges for metathesis. Triconsonantal verb roots with a guttural as their first consonant show metathesis or pseudometathesis whenever they take a prefix. However, when the prefix is the first-person singular ʔa-, the surface form exhibits epenthesis only, as in (5), repeated in (24) for convenience.

(24).	a. /ʔaħsib /	[ʔa.ħa.sib]	‘I count’
	b. /ʔaʃrif/	[ʔa.ʃa.rif]	‘I know’
	c. /ʔaʁsil/	[ʔa.ʁa.sil]	‘I wash’
	d. /ʔahrub/	[ʔa.ha.rub]	‘I run’

Words such as those in (24) might pose another challenge for the alternative approach, since there is an insertion of a low vowel again after the guttural in the triggering environment. Note that such words exhibit medial light syllables, yet no deletion occurs, and therefore no metathesis is attested (see (25)).

(25). *Evaluation of [ʔaħsib] ‘I Count’*

/ʔa _j ħsib/	*aGC	*LL	DEP-IO	MAX-IO	Linearity
a. ʔa _j ħ.sib	*!				
☞ b. ʔ.ħa _j .sib					*
☹ c. ʔa _j .ħa _k .sib		*!	*		
d. ʔ.ħa _k .sib			*!		

In the tableau, (a) is immediately eliminated for violating *aGC. Similarly, (c) is ruled out due to a fatal violation of *LL. Thus, (b) should be the optimal form, since it only violates low-ranked Linearity, but this is not the actual word.

In my approach, this problem is not avoided either. How could the derivation for the desired candidate (c) be justified? If syncope were to apply, this would incorrectly predict the output *[ʔ.ħasib]. I propose that two factors can block the application of syncope, one morphological and the other phonological. First, the underlying vowel carries a grammatical contribution, because ʔa- is the first-person singular prefix. Unlike in other suffixes such as -ja (third-person singular masculine) or ta- (second-person singular / third-person singular feminine), the deletion of this low vowel would lead to the loss of the entire grammatical category. This is because the glottal stop [ʔ] is epenthetic, added only to repair an onsetless syllable. Thus, if the low vowel from ʔa- does not surface, neither will the glottal stop.

The second reason is phonological. Even if deleting the first vowel did not result in a grammatical loss, the hypothetical word would have two gutturals appearing next to one another, possibly within the same syllable onset, a pattern not attested in SNA, e.g., *[ʔħsib] ‘I count.’

Arabic dialects have a tendency to avoid two gutturals within a syllable, a pattern that holds for derived words. Thus, it is intuitive to assume the syncope is blocked to avoid two gutturals in a syllable. This can be explained by the Obligatory Contour Principle (OCP), which was introduced in OT by Rose (2000) as “A sequence of adjacent identical segments is disallowed” (p. 4). This constraint has to be ranked above *LL to rule out a form like (b) in Table 64: *aGC, Linearity, OCP >> *LL, DEP-IO >> MAX-IO. With the introduction of OCP, it is possible to look at the derivation for [ʔaħsib] in (26).

(26). *Evaluation of [ʔaħsib] ‘I Count’*

/ʔa _j ħsib/	*aGC	Linearity	OCP	*LL	DEP-IO	MAX-IO
a. ʔa _j ħ.sib	*!					
b. ʔ.ha _j .sib		*!	*			
☞ c. ʔa _j .ħa _k .sib				*	*	
d. ʔ.ħa _k .sib			*!		*	*

In the tableau above, candidate (a) is immediately eliminated due to the fatal violation of *aGC, whereas (b) and (d) both violate another highly ranked constraint, OCP. Candidate (c) is therefore the winner since it violates a now relatively lower-ranked constraint, *LL. While such a constraint could also be employed in a traditional approach to metathesis, this approach is more consistent and shows independent evidence for both epenthesis and syncope, making it superior.

4.4.3 The Nature of *aGC

I have thus far modeled a new OT approach where guttural metathesis is reanalyzed as two independent processes. Nonetheless, I have not yet defined the nature of the proposed constraint *aGC. What kind of constraint (or constraints) would trigger low vowel epenthesis in the /aGC/ environment? On the one hand, the gutturals in SNA can appear after a low vowel without restriction. On the other hand, gutturals may appear before a consonant when preceded by other vowels, i.e., high vowels. The key question is why the guttural avoids a preconsonantal

position only if it is preceded by a low vowel. On its own, a single constraint prohibiting such a sequence seems unmotivated, and I argue there are two constraints to be violated.

To answer this question, I need to investigate whether a sequence of aGC is actually marked. As mentioned earlier, Najdi Arabic is not the only Arabic dialect or language that considers a sequence of aGC to be marked. Several Arabic dialects, such as Bedouin Hijazi Arabic and Negev Arabic, and some Hebrew dialects treat this sequence similarly. Apart from the Semitic languages, the same sequence is prohibited by Rendille, an Afro-Asiatic language of the Cushitic group spoken in eastern Kenya. In Rendille, there is a general rule that applies to nouns and verbs when adding a vowel-initial suffix. The rule deletes the last vowel of the root, which results in a CC structure with re-syllabification (Heine, 1976, 1978; Oomen, 1981; Sim, 1981; Zaborski, 1986). This is demonstrated in (27).

- (27). a. /nabaħ-o/ [nab.ħo] ‘ears’
 b. /umah-e/ [um.he] ‘I/she begin(s)’

However, in Rendille, there is one restriction on the pharyngeal fricative [ħ], which is that it must not be in a preconsonantal position when following the pharyngeal vowel /a/ (Hume, 1998, 2001). When deletion creates such an environment, the pharyngeal is switched with the following consonant, as shown in (28).

- (28). a. /baħab-o/ */baħbo/ [babħo] ‘armpit’
 b. /aħam-a/ */aħma/ [amħa] ‘eat’
 c. /yaħar-a/ */yaħra/ [yarħa] ‘cough’

Interestingly, it is possible for the pharyngeal to occur preconsonantly if not preceded by a pharyngeal vowel, e.g., [liħti], *[liħi] ‘rock.’ Also, the examples in (28) show it is possible for the pharyngeal to appear next to /a/ as long as there is no following consonant, e.g., [nabaħ] ‘ear,’ [amħa] ‘eat.’

To account for these complex conditioning factors, Hume (2001) analyzed this behavior using a coordinated constraint approach: one macro-constraint composed of two micro-constraints. Micro-constraints make up one larger constraint that can be satisfied even if one of its micro-constraints is violated. In this view, unless a given candidate violates both parts of the macro-constraint, it will pass the macro-constraint, as stated in (29).

- (29). Macro-constraint:
 a. *phar/V__C (No pharyngeal is allowed after a vowel and before a consonant)
 b. *[phar]/[phar] (Two pharyngeals are not allowed)

Given that a low vowel has a pharyngeal feature, Hume (2001) used these two micro-constraints to explain the Rendille data. This is illustrated in (30), taken from Hume (2001, p. 22).

(30). *Conjoined Constraints in Rendille*

1	/baħab-o/	*Pharyngeal/C	*Phar/Phar	Linearity
	a. baħbo	(*)!	(*)!	
	☞ b. babħo			*
2	/aħam-a/			
	a. aħma	(*)!	(*)!	
	☞ b. amħa	(*)	(*)	*
3	/liħti/			
	☞ a. liħti	(*)	(*)	
	b. lithi			*!
4	/nabaħ/			
	☞ a. nabaħ	(*)	(*)	
	b. nabħa	(*)	(*)	*!

As seen in the tableau, candidate (1a) shows a violation of both micro-constraints, and therefore candidate (1b) is the winner since it only incurs a violation of the lower-ranked Linearity. Similarly, candidate (2b) is the winner since it fully satisfies the top-ranked constraint. Even though (2b) violates one of the micro-constraints (*Phar/Phar), it still passes the macro-constraint. For (3) and (4), these sets of candidates satisfy the macro-constraint although each

partially incurs a violation. Therefore, (3a) and (4a) are optimal, because they satisfy the lower-ranked Linearity.

The data in Rendille show the same environment that triggers guttural pseudometathesis. In other words, both Najdi Arabic and Rendille have the same requirement; a pharyngeal must not precede another consonant if it follows a low vowel. The languages differ, however, in satisfying that requirement. Rendille shows a CC metathesis, whereas in Najdi Arabic, a low vowel is inserted after a guttural.

Following Hume (2001) and Crowhurst and Hewitt (1997), I argue there is one macro-constraint composed of two micro-constraints. The first micro-constraint prohibits a guttural from appearing before another consonant (*Guttural/C: no guttural before a consonant). The second prohibits two pharyngeal segments from appearing in adjacent positions (*Phar/Phar: no sequence of two pharyngeal segments). Given that a low vowel is [+pharyngeal], a low vowel should also be marked with a violation when it appears next to another pharyngeal segment.

The difference between coordinated and regular constraints is that macro-constraints can be satisfied even if only one of the two micro-constraints is satisfied, and they are violated when each of the two micro-constraints assigns a violation mark. By incorporating this coordination of constraints, I analyze pseudometathesis in SNA in (31).

(31). *Evaluation of [mʁasu:l] ‘Washed’*

/ma _j ʁsu:l/	*aGC		Linearity	*LL	DEP-IO	MAX-IO
	*Guttural/C	*Phar/Phar				
a. ma _j ʁa _k su:l	(*)		*!	*	
b. m.ʁa _j .su:l			*!			
c. ma _j ʁ.su:l	(*	*)!				
d. m.ʁa _k .su:l	(*)			*	*

Note that the micro-constraints are both violated in (b) only, so a fatal violation is incurred. Consequently, this form is ruled out. With the competition between the last three candidates, (d) is predictably the winner.

Given the same macro-constraint, it is possible to see why a sequence like iGC or uGC can surface in Najdi Arabic. The evaluation in (32) shows the derivation of the word [wiḥdah] ‘loneliness.’

(32). *Evaluation of [wiḥdah] ‘Loneliness’*

/wiḥdah/	*aGC		Linearity	*LL	DEP-IO	MAX-IO
	*Guttural/C	*Phar/Phar				
ا. wiḥ.dah	(*)				
ب. wi.ḥa.dah	(*)		*!	*	
ج. w.ḥi.dah	()	*!			
د. w.ḥa.dah					*!	*

In this tableau, neither (a) nor (b) violates both parts of *aGC, so they pass the macro-constraint. However, candidate (b) is ruled out for incurring a fatal violation of *LL. With no obligation for any change, candidate (a) is the winner.

The markedness of the sequence /aGC/ was justified by two sub-parts of a larger constraint. While each of these parts is individually violable, the violation of the two parts is fatal. Therefore, input forms that violate these two micro-constraints in SNA are repaired.

4.4.4 Stratal OT and Guttural Pseudometathesis

Thus far, I have analyzed so-called guttural metathesis within an OT framework. Since there is no opacity in this process, Stratal OT is not needed. However, this section shows that Stratal OT can provide an additional argument for an epenthesis plus deletion approach. To begin, I establish at what level the constraint *aGC becomes available. Using the previous example /gahwah/, the tableau in (33) assumes the macro-constraint in *aGC is top-ranked at the stem level. For simplicity, I refer to the macro-constraint as *aGC hereafter.

(33). *Stem-Level Evaluation of [ghawah] ‘Coffee’*

/ga _j hwah/	*aGC	Linearity	*LL	DEP-IO	MAX-IO
a. ga _j h.wah	*!				
☞ b. g.ha _k .wah				*	*
c. ga _j .h.a _k wah			*!	*	
d. g.ha _j .wah		*!			

In this tableau, (b) is selected as the winner and would serve as the input to the word level. The tableau in (34) moves to the word level, where—according to a null hypothesis—the constraint ranking is the same.

(34). *Word-Level Evaluation of [ghawah] ‘Coffee’*

/gha _k wah/	*aGC	Linearity	*LL	DEP-IO	MAX-IO
a. ga _k h.wah	*!	*			
b. ga _n .ha _k .wah			*!	*	
☞ c. g.ha _k .wah					

At the word level, there is no obligation to make any change from input to output. Therefore, the most faithful candidate, (c), is selected as the winner. The tableau in (35) tests a different scenario, in which *aGC is not operative at the stem level but is highly-ranked at the word level.

(35). *Stem-Level Evaluation of [ghawah] ‘Coffee’*

/ga _j hwah/	Linearity	*LL	DEP-IO	MAX-IO
☞ a. ga _j h.wah				
b. g.ha _k .wah			*!	*
c. ga.ha.wah		*!	*	
d. g.ha _j .wah	*!			

In this tableau, the winner is the most faithful form, (a), since /*aGC/ is not operative yet (or is so low ranked as to not affect the outcome). At the word level, then, the input is identical to the original underlying form, as shown in (36).

(36). *Word-Level Evaluation of [ghawah] ‘Coffee’*

/ga _j hwah/	*aGC	Linearity	*LL	DEP-IO	MAX-IO
a. ga _j hwah	*!				
☞ b. g.ha _k wah				*	*
c. ga _j ha _k wah			*!	*	
d. g.ha _j wah		*!			

In this evaluation, the desired form still wins. However, across these two scenarios, the intermediate form is different. In the evaluation of other forms, this would lead to undesired results. More particularly, when other processes interact, the stage where *aGC is stipulated turns out to be crucial. For instance, when the possessive suffix -i ‘my’ is added, each scenario would lead to different output forms, as shown in (37).

(37). *Stem-Level Evaluation of [ghaw.ti] ‘My Coffee’*

/ga _j hwah/	Linearity	*LL	DEP-IO	MAX-IO
☞ a. ga _j hwah				
b. g.ha _k wah			*!	*
c. ga _j ha _k wah		*!	*	
d. g.ha _j wah	*!			

At the stem level, when *aGC is not operative, no changes are expected, so the output matches the input.

(38). *Word-Level Evaluation of [ghawti] ‘My Coffee’*

/ga _j hwat-i/	*aGC	Linearity	*LL	DEP-IO	AL-R-R	MAX-IO
a. gah.wa.ti	*!				*	
☞ b. ga.haw.ti				*		
☹ c. g.ha _j w.ti		*!				
d. ga _j .ha _k .wi.ti			*!		*	
e. g.ha _k w.ti				*		*!*

At the word level, however, a problem arises where candidates like (b) are predicted to be optimal in (38). This is not the actual form, which is (d). These tableaux show that stipulating

*aGC at the word level only leads to an undesired output. These problems are avoided if *aGC is stipulated at the stem level, as in (39).

(39). *Stem-Level Evaluation of [ghawti] ‘My Coffee’*

/ga _j hwah/	*aGC	Linearity	*LL	DEP-IO	MAX-IO
a. ga _j h.wah	*!				
☞ b. g.ha _k .wah				*	*
c. ga _j ha _k wah			*!	*	
d. g.ha _j wah		*!			

(40). *Word-Level Evaluation of [ghawti] ‘My Coffee’*

/g.ha _k wat-i/	*aGC	Linearity	*LL	DEP-IO	AL-R-R	MAX-IO
a. ga _n haw.ti				*!		*
b. ga _k h.wi.ti	*	*!			*	
c. g.ha _k .wi.ti			*!		*	
☞ d. g.ha _k w.ti						*

The undesired candidate that was shown in (38) is now ruled out in (40). To delete the feminine suffix and satisfy *LL, the repair is costly with multiple violations of DEP-IO and MAX-IO. In contrast, the actual form (d) is shown to be the optimal one, given that only deletion of the feminine vowel incurs a violation to MAX-IO. This shows that the intermediate form is crucial for deriving the right output.

So far, I have shown that Stratal OT can adequately analyze guttural pseudometathesis in SNA. Below, I employ more examples. In some words, only epenthesis takes place, such as /baʃd/ > [baʃad] ‘after.’ If I analyze words that derived from such roots via suffixation, epenthesis is shown to take place at the stem level, producing forms like [baʃad] ‘after,’ but deletion takes place at the word level, producing forms like [bʃadi] ‘after me’ (see (41)).

(41). *Stem-Level Evaluation of [bʕadi] ‘After Me’*

/ba _j ʕd-/	*aGC	Linearity	*LL	DEP-IO	MAX-IO
a. baʕd	*!				
b. b.ʕa _j d		*!			
☞ c. ba _j .ʕa _k d				*	*
d. b.ʕad				*	*!

At the stem level, only epenthesis is motivated to avoid a fatal violation of *aGC. Note that deletion is not enforced for this example, since *LL is not at stake when epenthesis occurs. Therefore, the winner is candidate (c).

When the suffix is attached at the word level in (42), a sequence of light syllables arises, which incurs a violation of *LL. Thus, syncope is required. Only the first vowel can avoid fatal violations of higher constraints, so (d) is selected as the optimal form.

(42). *Word-Level Evaluation of [bʕadi] ‘After Me’*

/ba _j ʕa _k d-i/	*aGC	Linearity	*LL	DEP-IO	MAX-IO
a. ba _j ʕ.di	*!				*
b. bʕa _j .di		*!			*
c. ba _j .ʕa _k .di			*!		
☞ d. bʕa _k .di					*

The last couple of derivations pose another challenge to a traditional metathesis approach. This approach would justify stem words like [baʕad] as realized with epenthesis only. Nonetheless, words derived from this stem via suffixation undergo metathesis, as in [b.ʕadi]. If *aGC were operative at the stem level, this would rule out any type of metathesis with such words. On the other hand, within my approach, all words undergo a single strategy to the marked sequence *aGC. Post-guttural /a/ epenthesis always occurs at the stem level, and deletion follows at the word level only when necessary (enforced by *LL). Furthermore, syncope operates throughout the language to prohibit medial light syllables.

There is yet more evidence that CVCVC words undergo syncope of the first vowel when the stem is attached to a vowel-initial suffix, as illustrated in (43).

- (43). a. /warag+i/ [w.rigi] 'my paper'
b. /walad+i/ [w.lidi] 'my son'
c. /balad+i/ [b.lidi] 'my town'
d. /ʕarab+i/ [ʕ.ribi] 'Arab'

The examples in (43) reveal a pattern that results in deleting the first vowel if the suffix /i/ attaches to the stem. This supports the idea that a word like [bʕadi] is actually formed by syncope of the first vowel, which in turn happens after initial post-guttural epenthesis. In other words, the underlying representation /baʕdi/ transforms at some point to an intermediate form [baʕad-i], then later surfaces as [bʕadi].

This section has shown that pseudometathesis can successfully be analyzed within Stratal OT. This challenges the traditional approach where gutturals metathesize with a preceding low vowel. In contrast, there is ample evidence for pseudometathesis, where preconsonantal gutturals trigger epenthesis only, and deletion occurs when independently required.

4.5 Apparent Counterexamples

Above, I demonstrated how the derivation works for guttural pseudometathesis in a special version of OT called Stratal OT. I compared my approach against a typical metathesis approach and showed why a two-stage analysis is strongly motivated. In this section, I present potential counterexamples to my analysis and explain why these exceptions are not problematic.

The first type of exception concerns quadri-consonantal CVCCVC verbs, which are verbs with four consonants. In these verbs, the guttural remains intact even if it occurs in preconsonantal position and follows the low vowel /a/: CaGCCVC / *CaGaCVC, as in (44).

- (44). a. ʔaʕtʕab ‘he damaged’
 b. ʔaʕnaz ‘he/it stank’
 c. ʔaʕðʕar ‘it turned green’
 d. ʔaʕwa ‘he misled’
 e. ʔaʕrag ‘he soaked/drowned someone’
 f. ʔahda ‘he gifted’
 g. ʔaħradʒ ‘he embarrassed’

While these examples do not metathesize (or more accurately, do not show post-guttural epenthesis), there might be a good explanation for their behavior. An interesting fact about these perfective ʔaGCVC verbs is that they match different verbs and nouns in the dialect. As a result, if they triggered post-guttural epenthesis, the hypothetical result would become identical to other related forms, namely imperfective verbs or even nouns: ʔaGCVC > ʔaGaCVC. As a matter of fact, if post guttural epenthesis were applied, some of the words in (26) would be realized as distinct words, as in (45).

- | | | | | | | |
|-------|----|---------|-----------------------------|---------|----------|--------------------|
| (45). | a. | ʔaʕtʕab | ‘he damaged’ | ʔaʕtʕab | ʔaʕatʕab | ‘paralyzed’ |
| | b. | ʔaʕðʕar | ‘it turned green’ | ʔaʕðʕar | ʔaʕaðʕar | ‘green’ |
| | c. | ʔaʕwa | ‘he misled’ | ʔaʕwa | ʔaʕawa | ‘I make a mistake’ |
| | d. | ʔaʕrag | ‘he soaked/drowned someone’ | ʔaʕrag | ʔaʕarag | ‘I drown’ |
| | e. | ʔahda | ‘he gifted’ | ʔahda | ʔahada | ‘I calm’ |

These pairs of underlying homophones not only differ in meaning but also in their roots. While the verbs on the left in (45) are of quadri-consonantal roots, their counterparts on the right are derived by attaching the glottal or prefix ʔa- to a triconsonantal root. Thus, it seems reasonable to claim these exceptions avoid epenthesis to maintain lexical distinctiveness.

Another group of counterexamples comes from forms that have the guttural preceding a consonant that is either a suffix or part of a suffix (or potentially an infix), as in (46).

- (46). a. manaʕt ‘I disallowed’
 b. midahna ‘we praised’
 c. nifaʕna ‘we blew’
 d. ʔaʕtirif ‘I confess’
 e. ʔaʕtibir ‘I examine’
 f. ʔaʕtisil ‘I take a shower’

In (46), each guttural occurs in the triggering environment for epenthesis, yet no epenthesis takes place, and in each of these forms, the following consonant is not part of the stem. Thus, the post-guttural epenthesis might only be applicable within morphemes and not across morpheme boundaries, which would not be a surprising finding. Justifying the existence of these exceptions was beyond the scope of this study, so further research is needed to address their behavior.

4.6 Conclusion

This chapter has argued that synchronic guttural metathesis in SNA is not actual metathesis but rather a “pseudometathesis” resulting from a two-step process: epenthesis plus deletion. This argument was supported by forms that show epenthesis only after the guttural in the given environment. It was also supported by the existence of similar languages that show epenthesis in the same environment but with no deletion: aGC > aGaC. Similarly, syncope was shown to be a synchronic process applied almost freely in Najdi Arabic. I argued that the sequence aGC is generally a marked form, a fact best captured under a constraint-based approach. First, epenthesis occurs to repair the marked form. Then, a general constraint (*LL) targets short vowels in sequences of light syllables. With respect to this markedness constraint, I utilized macro-constraints to justify the preconsonantal gutturals after different vowels. This analysis was also maintained within Stratal OT, a version of OT that makes it possible to represent multiple changes in serially ordered stages. Finally, I presented counterexamples that do not fit neatly into this approach and speculated that certain morphological restrictions, such as lexical distinctness and morpheme domain restrictions, are probable causes for these behaviors.

Chapter 5: Stress Patterns and Foot Construction in SNA

5.1 Introduction

The previous chapters described the principles for syllable representation and syllable weight in SNA. This chapter discusses suprasegmental processes built on the existence of the syllable: metrical structure and stress assignment. Since previous chapters explored phonological phenomena related to stress, one of the aims of this chapter is to investigate whether stress conditions are influenced by any phonological processes in SNA.

Earlier works on Arabic phonology have provided thorough analyses of Modern Standard Arabic and Classical Arabic, and recent studies have shifted interest toward modern spoken dialects. Some of these works have focused on stress patterns and foot construction (e.g., Abu-Slim, 1982; Adra, 1999; Alahmari, 2018; Al-Alhuwaykim, 2018; Al-Qahtani, 2014; Al-Solami, 2020; Bamakhramah, 2009; Kabrah, 2004; Kager, 2009; Kenstowicz, 1980; McCarthy, 1979a; Watson, 2002). While there is agreement that stress in Arabic is sensitive to syllable weight, other factors such as syllable position within the word may also play a role.

Despite the richness in the literature on modern Arabic vernaculars and what is known about stress algorithms, few dialects remain under-reported. One such example is SNA. Although stress in SNA, like many Arabic dialects, is sensitive to weight and syllable position, it also differs in the way stress is assigned when words end in two light syllables. Furthermore, other phonological processes play a role in determining stress, such as long vowel shortening and degemination. This chapter examines stress in SNA, including an analysis of the foot system. First, the chapter provides a basic overview and tentative analysis of stress in some dialects of Arabic. Then, it presents aspects of the stress system in SNA, including some of its unique characteristics. Finally, it analyzes the stress and foot construction in SNA within an OT model.

5.2 Stress Assignment in Arabic

Several factors influence stress assignment in Arabic. McCarthy (1979a, 1979b) found two key factors were syllable weight and position. According to McCarthy, syllable weight can be measured by means of moras; the rhyme of the syllable is the only part that contributes to weight. A singleton vowel represents one mora, and a singleton coda also represents one mora. It is worth mentioning that stress is not phonemic in Modern Standard Arabic, and this generalization extends to many dialects of Arabic. Watson (2011) argued that only one of the last three syllables can attract syllables in Classical Arabic. Hayes's (2011) analysis of stress in Classical Arabic showed that stress is penultimate. However, if the penult is light, the preceding syllable, if any, is stressed, as shown in (1).

- (1). 'ka.tab 'he wrote'
'qa.lam 'pen'
'mak.tab 'office'
'ka:.ti.bih 'writer (f)'
'mak.ta.bah 'library'
'wa.ra.qah 'a piece of paper'

Watson (2011) added another rule that if the final syllable is superheavy, the final syllable must get stressed, as in (2).

- (2). ka:.ti.'bu:n 'writers (m)'
maḍʒ.'nu:n 'crazy'
ḍʒa.'di:d 'new'
mak.ta.'ba:t 'libraries'

Given all possible syllable weights, although Modern Standard Arabic seems to have quantity-sensitive stress algorithms, the location of the syllable is crucial as well. Another observation revealed by the data is the behavior of word-final CVC. In (1), a heavy syllable bears stress if it is the heaviest syllable between the penult and antepenult, yet it is ignored by stress on

the final syllable even if preceded by two light syllables, e.g., ['wa.ra.qah]. This issue is discussed in the following section.

5.2.1 The Role of Extrametricality in Arabic

A general observation about most Arabic dialects concerns the stress placement of final heavy CVC syllables. Hayes (1982) argued that even though final CVC syllables had codas, they did not add to the weight of the syllable. This was evident in stress patterns in many Arabic dialects, because a final CVC behaved like a light CV syllable (Alber, 2005). One proposal to account for the structure of final heavy syllables is extrametricality, introduced by Liberman and Prince (1977) and later developed by Archangeli (1984), Hayes (1979), and Pulleybank (1986).

Hayes (1982) developed the concept of extrametricality at different levels. In his analysis, extrametricality may render an entire peripheral syllable or foot invisible to stress assignment. Halle and Vergnaud (1987) argued for an additional rule that “only a single entity may be marked extrametrical” (p. 58). In this sense, penultimate or antepenultimate stress can be explained by rendering the last syllable or last foot extrametrical. Hayes (1995) suggested the following restrictions on extrametricality:

- (3). Extrametricality Rule:
 - a. Constituency: Only constituents (segment, syllable, foot, phonological word, affix) may be marked as extrametrical.
 - b. Peripherality: A constituent may be extrametrical only if it is at a designated edge (left or right) of its domain.
 - c. Edge Markedness: The unmarked edge for extrametricality is the right edge.
 - d. Nonexhaustivity: An extrametricality rule is blocked if it would render the entire domain of the stress rules extrametrical.” (pp. 57–58)

The concept of extrametricality refers to either syllables or segments (often consonants) that do not take part in the syllabification system and consequently appear invisible to stress rules. This behavior impacts stress patterns and syllable structures. According to Liberman and Prince (1977), a segment may be extrametrical only in peripheral positions, such as word-finally.

Hayes (1995) applied this concept to Cairene Arabic, finding that only the peripheral consonant showed extrametricality. Conventionally, an extrametrical consonant is marked with <angled brackets>. In this regard, a superheavy CVCC or CVVC syllable is considered heavy just like CVC and CVV, respectively, with the final consonant being extrametrical. Thus, the distribution of syllable shapes depends on word position, as illustrated in (4).

(4).	Final	Non-Final
	CV	CV
	CV<C>	CVC
	CVV<C>	CVVC
	CVC<C>	CVCC

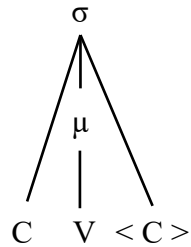
According to Kiparsky (2003) following Itô (1986, 1989), the behavior of extrametricality in most modern Arabic dialects can be attributed to the Prosodic Licensing Principle, which requires each segment to be attached to a higher prosodic constituent. Unlike Liberman and Prince (1977), Kiparsky (2003) argued that extrametrical segments were not limited to word-final position. Under Kiparsky's semisyllable approach, all floating segments were licensed by the prosodic word and not affiliated with any syllable. This accounts for peripheral consonants in final and non-final syllables. Nonetheless, his work is limited to the construction of superheavy syllables (see Figure 16).

For the analysis of stress, the relevant prediction is that a final heavy syllable does not attract stress. Meanwhile, a superheavy syllable should attract stress, since its heaviness is maintained even if the last consonant is omitted. This pattern holds true for most Bedouin dialects, where a CVC syllable may attract stress only if it appears in word non-final position. If it occurs word-finally, a CVC syllable acts as if it were light.

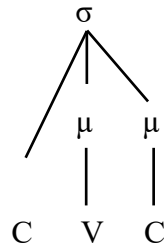
Figure 16

Word-Final and Word Non-Final CVC

a. Word-Final CVC



b. Word Non-Final CVC



Recent works on stress in Najdi dialects have highlighted the different behavior of word-final CVC syllables. In Central Najdi, for instance, Al-Qahtani (2014) and Al-Hammad (2019) attributed stress patterns to the extrametricality of a marginal consonant. The concept of extrametricality may extend to other cases. Following Hayes (1979, 1982, 1995), Al-Solami (2020) reported that an extrametrical segment within a larger extrametrical constituent is possible. He suggested that the whole CVC syllable should be extrametrical, <CVC>. Other works like Alahmari's (2018) study on Southern Saudi Arabic have suggested that even larger constituents may become extrametrical if they occur at a word periphery, e.g., a final binary foot. In fact, the notion of foot extrametricality appears valid in many other dialects, such as San'ani ['katabatih] 'she wrote it (m)' and Palestinian Arabic ['dar.rast] (Watson, 2011), where stress is assigned to the rightmost visible foot, as in ['(kata)<(bati)>] and ['dar.<rast>].

While extrametricality seems typical in Arabic dialects, its domain may vary from peripheral consonants to certain syllables or even feet, depending on the dialect. An obvious issue with these approaches is that extrametricality is only associated with one type of syllable. In analyzing the data from SNA, I show that extrametricality is more consistent and applies to one constituent (every word-peripheral consonant) regardless of the syllable that contains it.

5.3 Stress in SNA

The stress patterns in SNA are similar to many Arabic dialects, in that factors like syllable weight and position help determine stress assignment. As mentioned earlier, SNA has the syllable shapes shown in (5).

- (5). a. Light CV
 b. Heavy CVV, CVC
 c. Superheavy CVCC, CVVC, CVG, CVVG

Given all possible syllable structures, any syllable type may attract stress depending on its weight (light vs. heavy) and position (e.g., ultimate, penultimate). All possible stress assignments are summarized in (6).

- (6). Stress on a final superheavy syllable
 a. ki.'tabt 'I wrote'
 b. ni.'zalt 'you stepped down'
 c. gi.'di:m 'old (m)'
 d. ʔax.'ba:r 'news'
 e. ʔil.'xe:r 'the good'
 f. dʒa:d.'di:n 'serious (plural)'

Stress on a superheavy penultimate syllable

- g. 'jakt.bih 'he writes it'
 h. ri.'samt.lih 'I drew for him'
 i. 'ka:t.bah 'a writer (f)'
 j. 'dʒa:r.kum 'your neighbor (m)'
 k. 'kall.mih 'talk to him!'
 l. 'ra:d.dih 'returning him/it'

The data in (6) show that a final superheavy syllable bears stress regardless of the shape of the preceding syllable. In addition, if the word has one superheavy syllable and it is penultimate, that syllable receives stress. Interestingly, the heavy syllable is more likely to carry stress if neither of the last two syllables is superheavy, as shown in (7).

Note that if the superheavy syllable is antepenultimate, it is outside the domain of stress, as in (7e). Moreover, the heavy syllable can bear stress if it is antepenultimate and followed by

two light syllables, as in (7f-i). A light penult syllable may also receive stress if the ultimate is not superheavy, as shown in (8).

- (7). Stress on a heavy penultimate syllable
- a. ki.'tab.tih 'I wrote him/it'
 - b. 'ʃif.tik 'I saw you'
 - c. mak.'tab.na 'our office'
 - d. 'be:.tih 'his house'
 - e. ga:b.'lat.kum 'accepted (f) you (plural)'

Stress on a heavy antepenultimate syllable

- f. 'mad.ri.sah 'school'
- g. 'haf.li.tih 'his party'
- h. 'min.ti.bih 'careful (m)'
- i. 'sa:.fa.rat 'she traveled'

- (8). Stress on a light penultimate syllable
- a. 'ki.tab 'he wrote'
 - b. 'ri.dʒaʃ 'he came back'
 - c. 'li.ga 'he found'
 - d. 'mi.da 'extent'

These patterns can be captured in the rules in (9).

- (9). Stress rules in SNA
- a. Stress falls on a superheavy ultimate syllable.
 - b. Otherwise, stress falls on a superheavy penultimate syllable.
 - c. Otherwise, stress falls on a heavy penultimate syllable.
 - d. Otherwise, stress falls on a heavy antepenultimate syllable.
 - e. Otherwise, stress falls on a light penultimate syllable.

Although the stress rules seem to operate on a ternary syllable weight distinction, these may also be characterized as binary distinctions depending on the word position, i.e., light and heavy syllables vs. superheavy syllables in word-final position, and light vs. heavy in other positions (McCarthy, 1979b). However, complications arise in the application of these rules for SNA. For instance, sometimes stress assignment ignores a heavy antepenultimate syllable and falls on a light penult instead, as in (10).

Heavy antepenults can bear stress when followed by two light syllables ('HLL), but the data in (10) contradict this pattern, calling for further investigation.

- (10). a. ʔaht.'ri.gat 'she/it (f) burned'
 b. ʔast.'li.mat. 'she received'
 c. ʔang.'ba.lat 'she got admitted'
 d. m.kall.'mi.tih 'has (f) talked to him'
 e. m.darr.'si.tih 'his teacher (f)'
 f. ka:t.'bi.tih 'his writer (f)'

Before I can explain such cases, I need to introduce the larger domain of stress, foot structure. In the following section, I shed light on these issues within Metrical Theory.

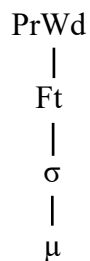
5.4 Stress and Foot Construction

5.4.1 Prosodic Theory and Metrical Phonology

Prosodic Theory defines various phonological processes as taking place on different tiers below the prosodic word. One of the major strengths of this approach is its ability to break prosodic words down into features with a hierarchical relationship (McCarthy & Prince, 1986, 1990a, 1990b; Selkirk, 1980, 1996). This hierarchy is composed of prosodic words, which dominate feet. Feet, in turn, dominate syllables, which dominate moras, which dominate segments, as illustrated in Figure 17, from McCarthy and Prince (1986) and Selkirk (1980).

Figure 17

Prosodic Hierarchy

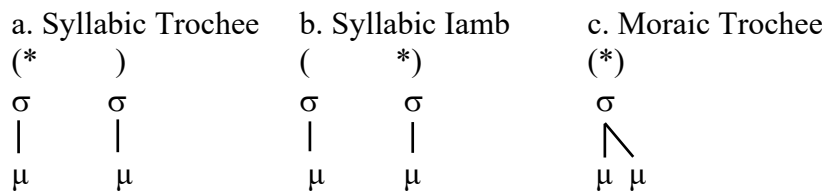


Prosodic Theory is intertwined with the Theory of Metrical Phonology, which analyzes stress algorithms using a hierarchical representation (Hayes, 1995; Liberman, 1975; Liberman &

Prince, 1977). In Metrical Theory, stress algorithms are accounted for with a foot system. Feet are constructed out of syllables and/or moras. Typically, a given number of syllables or moras are grouped under one foot. Within that foot, one syllable or mora receives stress. If the foot has an initial stressed syllable, it is a trochaic foot; if it has a final stressed syllable, it is an iambic foot (Hayes, 1995). A foot consists of a minimum of two moras, and a maximum of two syllables. Therefore, a single light syllable cannot generally form a foot on its own; if it does, it is known as a degenerate foot. Figure 18 shows foot shapes.

Figure 18

Foot Shapes



Note that the representation in (c) is monosyllabic, but Hayes (1995) argued that heavy syllables are trochaic, since the first mora is usually stronger than the second. Prince (1983) appealed to sonority patterns to make a similar argument.

Traditionally, Bedouin dialects of Arabic were assumed to possess a trochaic stress system, just as in Modern Standard Arabic (Al-Mozainy, 1981). However, Hayes (1995) reported that two Bedouin dialects, one spoken in eastern Libya and the other in the Negev, were actually iambic. Recent work has adopted Hayes' perspective. For example, McCarthy (2003, 2007) and Watson (2007) both strongly rejected the previous generalization that Bedouin dialects such as Hijazi Bedouin Arabic have a trochaic stress system. McCarthy used one phonological process, trisyllabic elision, as an argument for this conclusion. As noted earlier, according to his analysis, iambic feet have a tendency to undergo quantitative reinforcement with the prominent member.

Thus, an iamb of the shape LH would be favored over an iamb having the shape LL. This observation is captured by the Harmony Rule in (11).

(11). Harmony Rule: “In an iambic foot (x y), $|y| > |x|$.” (Prince, 1990, p. 6)

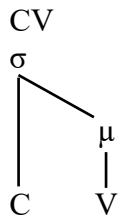
One way to satisfy the Harmony Rule would be to lengthen the strong constituent in the foot, which is the stressed vowel. An alternative would be to weaken or shorten the weak constituent. Based on these observations, McCarthy (2007) proposed that trisyllabic elision is one mechanism to prevent two equal members in an even iamb (CV.'CV.). To produce contrastive members, the unstressed vowel is deleted, producing (C.'CV.).

Although SNA has a quantity-sensitive system, position is crucial for even trochees, e.g., 'LL. Based on the foot shapes in Figure 18, SNA appears to possess (a) and (c), but no data support the existence of (b). In bisyllabic words consisting of two light syllables, the stress is always penultimate: 'si.ma 'sky,' 'ri.ga 'he climbed.' Even though SNA belongs to the Bedouin Arabic dialects, it has a trochaic system rather than an iambic one.

In SNA, a break-down of syllables into moras initially shows two types of syllables. First, there are monomoraic syllables, which are simply light syllables, as in Figure 19.

Figure 19

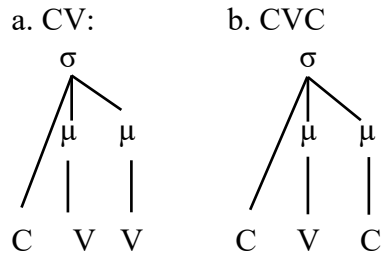
Monomoraic Syllable



Second, there are bimoraic heavy syllables, CVV and CVC, as in Figure 20. Earlier, I proposed that coda consonants are linked to moras by the Weight by Position (WBP) rule.

Figure 20

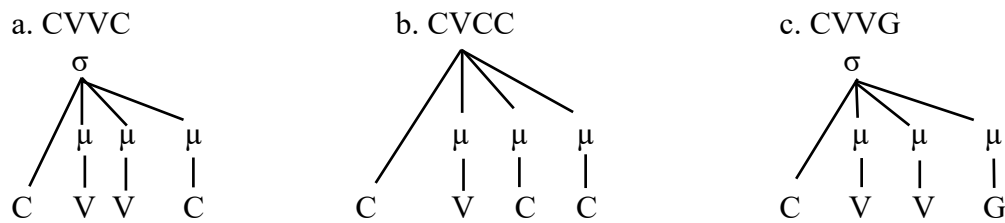
Bimoraic Heavy Syllables



Third, there are superheavy syllables, or simply trimoraic syllables, depending on how one interprets a syllable, shown in Figure 21.

Figure 21

Superheavy Syllables



Following Hayes' (1995) Metrical Theory, I propose that final extrametricality not only applies to CVC syllables but to all syllable types. In other words, other types of final syllables can also undergo peripheral consonant extrametricality. This claim is supported by empirical evidence. As already noted, superheavy syllables attract stress because the syllable is still heavy even if the final consonant is eliminated. Thus, a hypothetical trimoraic syllable will be reduced by extrametricality to a bimoraic syllable: CV μ C μ <C μ >, CV μ C μ <C μ >, CV μ V μ <G μ >.

Before moving on to the next section, I need to address issues with CVG syllables. Assuming a geminate equals two consonants, CVG syllables that occur word-finally should attract stress like CVVC and CVCC syllables do. However, the data contradict this conclusion, as shown in (12).

- (12). Final CVG
- | | |
|------------------|---------------|
| a. /'ji.ʃid<d>/ | 'he tightens' |
| b. /'ʔis.sad<d>/ | 'the dam' |
| c. /'miħtar<r>/ | 'heated' |
| d. /'min.fak<k>/ | 'untight' |
| e. /'maħal<l>/ | 'store' |

The examples in (12) show that a final CVG syllable does not attract stress, even if it appears to be superheavy. Chapter 2 went over two approaches to represent geminates: Metrical Theory, which renders a geminate as inherently moraic, and the skeletal approach, which treats a geminate as two C slots. Neither explains why a final geminate is weightless. For Metrical Theory to derive the correct result, I would need some mechanism to eliminate the underlying mora. For the skeletal approach, extrametricality blocks WBP from applying to the second part of the geminate and therefore converts a final CVG to a CVC, incorrectly predicting that the syllable should bear stress.

Alternatively, I propose that geminates in SNA must undergo degemination word-finally. In fact, word-final degemination is common cross-linguistically. Kent (1932) reported one of the conditions for degemination was word-initial or word-final position. Kiparsky (2015) cited that in several Bedouin Arabic dialects, final syllables were stressed just in case they were superheavy. Geminate consonants regularly shorten in word-final position so that an underlying superheavy /CVG/ syllable is recognized as heavy CVC. Broselow (1980) reported similar patterns in Iraqi Arabic. Assuming that final geminates are singleton consonants is the only way to justify the unpredictable stress in (12).

With this process, the dataset above is no longer problematic for my analysis. Accordingly, it becomes clear why a final CVG behaves like a light syllable, since it only consists of a singleton coda consonant. Thus, examples in (12) should be rewritten as in (13).

- (13). a. /jin.ʃidd/ > jin.ʃid [ˈjin.ʃi<d>] ‘it tightens’
 b. /ʔis.sadd/ > ʔis.sad [ˈʔis.sa<d>] ‘the dam’
 c. /miħtarr/ > miħtar [ˈmiħ.ta<r>] ‘heated’
 d. /min.fakk/ > min.fak [ˈmin.fa<k>] ‘untight’
 e. /mahall/ > mahal [ˈma.ħa<l>] ‘store’

This degemination process explains why a geminate in coda position behaves like a singleton consonant only in word-final position. First a geminate is reduced, and then a final consonant undergoes extrametricality. For stress purposes, a final underlying CVG is considered CV, and therefore stress falls on the preceding syllable. The following section further explains stress algorithms within the larger domain of metrical constructions.

5.4.2 Foot Construction in SNA

This section describes the metrical structures of SNA within Metrical Stress Theory (Hayes, 1995). I refer to the grid model of that theory, which consists of bracketed layered grids. These grids represent prominence (beats) in a hierarchical tier (moras, syllables, feet). First, I show that word-final consonants are always extrametrical. I argue that a degenerate foot (a single foot consisting of a single mora) is banned. Therefore, a foot must be binary at least. To this end, a foot may be monosyllabic or disyllabic. I also argue that a disyllabic foot is head-initial with stress on the first syllable, which presents a trochaic stress system. For words with multiple feet, the rightmost foot always carries the stress. This conforms with a universal parameter known as End Rule (Hayes, 1982, 1995). I explore the directionality of footing, entertaining two possibilities, and show that only left-to-right parsing can account for the stress rules in SNA. Lastly, I explain that SNA shows a trimoraic foot construction with superheavy syllables and heavy plus light syllables.

5.4.2.1 Binarity and Directionality of Foot Construction

To start off, I build on the assumption for now that feet are binary in principle, although this claim is revisited in the next section. Drawing on Al-Mozaini (1981), I propose that SNA has a trochaic stress system, not an iambic one. The clearest argument for this comes from SNA words with two light syllables, which receive stress on the leftmost syllable, suggesting a trochaic structure. Note that the asterisk (*) refers to stressed syllables, whereas the weight of the syllable is referred to by (˘) when it is light and by (◌) when heavy. Disyllabic trochee foot syllables (LL) are presented in (14) and (15).

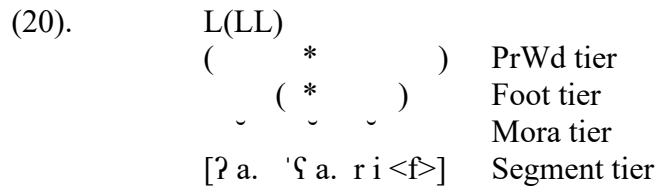
- (14). (*) PrWd tier
 (*) foot tier
 (˘) mora tier
 [' l i . g a] segment tier
- (15). (*) PrWd tier
 (*) foot tier
 (˘) mora tier
 [' s a . b i] segment tier

According to Hayes (1995), trochaic feet can also have the shape H; i.e., they can consist of a single heavy syllable, as shown in (16).

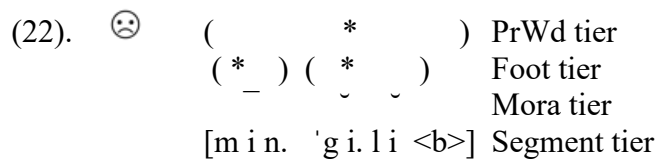
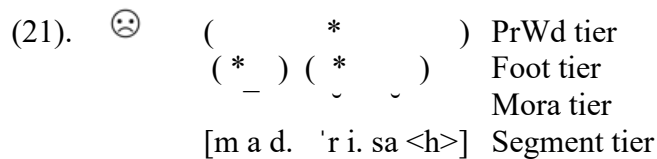
- (16). (*) PrWd tier
 (*) Foot tier
 (-) Mora tier
 [' b i n <t>] Segment tier

So far, the dataset shows words with one foot where stress predictably falls on the leftmost element in the foot. This is the main basis for arguing that feet in SNA are trochaic. But what happens when a word contains more than one foot? The answer to this question is determined independently from foot type. Cross-linguistically, the foot that receives stress is always at one edge of the word or another, and never word-medial, a fact that holds true for both trochaic and iambic languages. According to Hayes (1995), this fact is captured by a universal

[ri], remains unfooted, because there is no other mora to incorporate into a bimoraic foot. Assuming stress is trochaic, stress will be assigned to the first mora in the foot, ('ʔa.ʕa), producing an incorrect output. As an alternative, I test right-to-left foot construction in (20).



Starting at the right edge of the word, a bimoraic foot, (ʕa.ri), is constructed. The remaining mora that is visible, [ʔa], remains unfooted because there is no other mora to incorporate into a bimoraic foot. Assuming stress is trochaic, stress will be assigned to the first mora in the foot, ('ʕa.ri), producing the correct output. Based on (20), foot construction in SNA appears to occur from right to left. I examine more trisyllabic words in SNA in (21) and (22), turning to words with an HLL syllable pattern.



The examples in (21) and (22) are problematic for the current analysis, which predicts the wrong stress assignment. If trochaic feet are constructed from right to left and End Rule Right applies, I would expect a penult stress to be grammatical. Instead, the actual stress should be on the initial heavy syllable: ['mad.ri.sah] 'school,' ['min.gi.lib] 'flipped over.'

One solution to this problem would be skipping light syllables between constructed feet.

This is known in Hayes' (1995) Metrical Theory as weak local parsing (as opposed to strong local parsing), explained in (23).

- (23). Foot Parsing Locality Parameter:
 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 / ʔ/, where possible (Marked value of the parameter)." (Hayes, 1995, p. 308)

According to Hayes (1995), the difference between the two requirements is language-specific, because some languages keep feet constructed next to one another, while other languages keep them separated. One could argue that SNA has weak local parsing in foot construction. This solution works well for tetrasyllabic words with an HLHL shape, e.g., [ga:.ba.lat.hum] 'she met them' in (24).

- (24). (*) PrWd tier
 (*) (*) Foot tier
 ˘ ˘ Mora tier
 [g a:. b a. 'l a t. h u <m>] Segment tier

Unfortunately, the examples in (21) and (22) are still be problematic, since they end in two light syllables and therefore violate one crucial principle in Metrical Stress Theory, described in (25).

- (25). Persistent Footing:
 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." (Hayes 1995, p. 115)

Of interest is the second point of the persistent footing rule in (25b). If SNA has weak local parsing, then (21) and (22) will have the correct stress, but the last two syllables will be left unfooted, as shown in (26) and (27).

While right-to left parsing accounts for words with an LLL shape, it has its limitation in explaining forms with the shape HLL. In the following section, I explain that leftwards parsing is more adequate in handling the data, with one small modification.

5.4.2.2 Trimoraic Feet in SNA

One remaining issue with footing in SNA is that maximal size does not go beyond two moras. Chapter 2 proposed that syllables can be maximally trimoraic in word non-final position. With this assumption, feet must be trimoraic as well. Otherwise, a superheavy syllable cannot be formed under one foot. Thus, I propose that feet in SNA can also be trimoraic, as long as they do not exceed the maximum number of syllables, which is two.

Ternary feet represented by internally layered structures have been proposed in various studies over the years, such as Hayes (1980), McCarthy (1982), Leer (1985), Dresher and Lahiri (1991), Hewitt (1992), Rice (1992), Kager (1994), and more recently Bennett (2012), Kager (2012), and Martínez-Paricio (2013). Even in earlier works that explicitly rejected the concept of ternary feet, such structures were sometimes permissible due to stray syllable adjunction (e.g., Hayes, 1980, McCarthy, 1982; Prince, 1980; Selkirk, 1980; Yu, 2003, 2004). In Hayes' (1980) early description of stress, an unstressed, unfooted syllable may adjoin an adjacent foot, as stated in (31).

- (31). Stray Syllable Adjunction (Hayes, 1980, p. 73): “Adjoin a stray rime as a weak member of an adjacent foot.”

To represent this type of adjunction, one strategy is to abandon the Strict Layering Principle. Traditionally, strict layering dictates that every metrical element is dominated in its entirety by the next higher category on the prosodic hierarchy, as in Figure 22.

Building on Hayes (1980) and McCarthy (1982), Martínez-Paricio (2013) argued that ternary moras are not only possible but essential. The basic concept lies in internal recursive

layering instead of strict layering. Thus, the foot layer may undergo recursion to include any extra syllable that cannot be represented by binary branching, as illustrated Figure 23.

Figure 22

Strict Layering

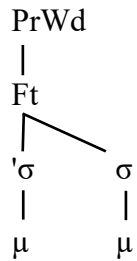


Figure 23

Recursive Layering with Binary Branching

- a. Bisyllabic foot + syllable b. Bimoraic foot + syllable

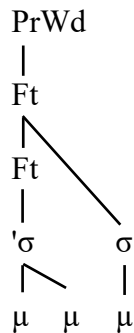
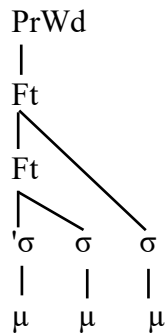


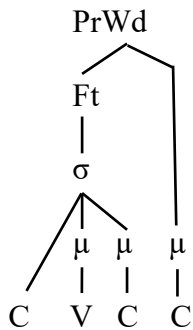
Figure 23 reveals that feet are parsed with two levels: 1) a bimoraic foot whether disyllabic or monosyllabic, and 2) an extra mora added at the upper foot node. The advantage of this model, according to Martínez-Paricio (2013), is twofold. First, it accounts for languages with reported ternary feet systems, which have been neglected in Metrical Theory. Second, recursive representation respects a longstanding principle in Metrical Theory, locality. Describing this concept, Hayes (1995) stated that “locality often takes the form of limiting what can be counted:

a reasonable conjecture is that phonological rules can count only to two” (p. 307). Hence, while flat ternary branching violates such a principle, recursive branching may preclude this violation.

In the analyses up to now, locality and the Strict Layering Principle appear to be violated. For instance, Kiparsky’s (2003) analysis of Arabic dialects assumed a peripheral consonant was a semisyllable that attached to the prosodic word rather than the foot (see Figure 24).

Figure 24

Semisyllable Attached to Prosodic Word



Other recent works on Arabic dialects have likewise analyzed peripheral consonants in CVXC syllables as attaching at different levels (e.g., Al-Hammad, 2018; Al-Solami, 2020; Huneety & Mashaqba, 2016; McCarthy & Prince, 1990a; Watson, 2007). However, I argue that only a recursive approach that can reveal the stress patterns associated with superheavy syllables in SNA. Assuming that the right peripheral consonant in CVXC syllables is part of the foot provides a more consistent model, because moraic consonants are proposed to add to the weight of the foot just as light syllables do.

Thus, I follow Martínez-Paricio’s (2013) description in representing the foot inventory of SNA. By adopting this proposal, a single foot could contain a heavy syllable plus a light syllable. Based on this, (21) and (22) can be reconstructed as (32) and (33). In (32) and (33), stress is now predictable without considering any foot extrametricality by parsing a trimoraic foot as a heavy

syllable followed by light syllables forming one foot, whereas the last syllable is left unparsed to avoid forming a degenerate foot.

(32). (*) PrWd tier
 (*) Foot tier
 (-) Mora tier
 [' m a d . r i . s a <h>] Segment tier

(33). (*) PrWd tier
 (*) Foot tier
 (-) Mora tier
 [' m i n . g i . l i] Segment tier

This parsing holds three advantages: 1) the foot is still binary in HL syllables, 2) it maintains the proposed trochaic system with head-initial prominence, and 3) it shows why neither of the last two syllables is stressed: because they do not form a foot in the first place.

How does the current analysis handle words with three light syllables, such as [ʔa.'ʕa.ri<f>]? The proposal, according to which feet may be maximally trimoraic but also maximally disyllabic, still predicts that a word starts with a light syllable and footing can skip the first syllable. Since the initial syllable leads to a degenerate foot, parsing ignores light syllables word-initially and moves forward to form any possible foot. According to Hayes (1995), skipping any light syllable is accounted for by the principle in (34).

(34). Priority Clause (Hayes, 1995, p. 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 principle reveals why words like [ʔa'ʕarif] ‘I know’ can have stress on the penultimate even if parsing is left to right, as in (35).

(35). L(LL)/ not (L'L)L:
 (*) PrWd tier
 (*) Foot tier
 (-) Mora tier
 [ʔ a . ' ʕ a . r i <f>] Segment tier

The metrical structure in (35) shows that a light syllable is skipped at the beginning of parsing. However, when the word ends with two light syllables, a foot must be converted under a foot which is enforced by the persistent footing rule. This pattern pertains to words with initial light syllables followed by superheavy ultimate syllables, which can be formed with one foot by skipping the first syllable. The examples in (36) and (37) show that the initial syllable is skipped by the priority clause to ban any degenerate foot. Then a foot is constructed over the superheavy syllable.

(36). (*) PrWd tier
 (*) Foot tier
 ˘ -) Mora tier
 [k i. 't a b <t>] Segment tier

(37). (*) PrWd tier
 (*) Foot tier
 ˘ -) Mora tier
 [g i. 'd e: <m>] Segment tier

Up to this point, I have shown that feet in SNA could be bimoraic or trimoraic as long as a trochaic system is maintained. Initially, I established that parsing is leftwards based on the stress location in trisyllabic words: L('LL) and ('HL)L. If parsing was right to left, I would expect [* (H) ('LL)] rightmost stress, which is not the case in SNA. Additionally, I proposed that initial light syllables are skipped over when parsing a foot. In the following section, I extend this analysis of foot structures to superheavy syllables, which I have argued to be trimoraic in SNA.

5.4.2.3 Superheavy Syllables in Metrical Phonology

So far, I have entertained the argument that SNA has a trochaic stress system and examined the formation of bimoraic and trimoraic disyllabic trochees, as well as moraic trochees of monosyllables. In this section, I examine words that consist of more than two superheavy syllables. Earlier, I stated that all syllable types undergo the peripherality condition known as

(41).	(*)	PrWd tier
	(*)	Foot tier
	(-)	Mora tier
	[' m a d . r i . s a <h>]	Segment tier

The example in (40) shows that a word with HLL syllable structure receives stress on the antepenult. Meanwhile, the example in (41) shows that a word with SHL syllable structure (where S is superheavy) receives stress on the penult. Assuming that superheavy syllables are trimoraic, stress on the antepenult would be expected in these cases. No approach has provided an answer for this behavior.

The discrepancy in (40) and (41) is another argument for trimoraic foot parsing. As noted before, a heavy syllable plus a light syllable forms one foot. This should be the case with (42). Based on this proposal, I can predict when a superheavy syllable is parsed into a foot, and a following light syllable can no longer be parsed into that same foot. If two syllables follow a superheavy syllable, they must form a foot and by End Rule Right, the last foot is stressed.

The examples in (42) and (43) show that a superheavy antepenultimate syllable does not bear stress because it is not the rightmost foot. In contrast, a heavy antepenult in an HLL word falls within a single foot, (HL)L. Thus, trimoraic parsing is the only way to distinguish heavy from superheavy syllables in antepenultimate position.

(42).	(*)	PrWd tier
	(*) (*)	Foot tier
	(-)	Mora tier
	[k a : t . b i . t i <h>]	Segment tier

(43).	(*)	PrWd tier
	(*) (*)	Foot tier
	(-)	Mora tier
	[m . ' d a r r . s i . t i <h>]	Segment tier

This section offered an algorithm for stress in SNA under Metrical Phonology. First, it was shown that SNA has a trochaic stress pattern, as SNA never has disyllabic words of even iambs (L'L) where the second part is more prominent. It was also shown that foot construction moves from left to right. While each parsing direction encountered challenges, left-to right was the most adequate. For initial light syllables, I referred to the Priority Clause, where monomoraic syllables can be skipped and parsing looks forward. Finally, I have claimed that SNA metrical representations can only be accounted for within trimoraic foot models. In this model, a superheavy syllable can form a single foot, as can a heavy syllable combined with a light syllable. In the following section, I address how to account for such patterns within OT.

5.5 Stress and Foot Construction in SNA in OT

In this section, I analyze foot construction and stress assignment in SNA within an OT approach, beginning with extrametricality. The constraint *Final-C- μ has been proposed to account for the failure of heavy/bimoraic syllables to attract stress in word-final position (Kager, 1999a). Next, I examine two scenarios for footing directionality under OT, showing that left-to-right footing fares better in SNA. Then, I show why a foot binarity approach cannot work with SNA and propose a modification to an OT constraint to accommodate the proposal for trimoraic feet. With a trimoraic constraint, I show that SNA favors maximal footing. I then explore the behavior of word-final CVG and CVVG geminates and show they can be accounted for within my model.

5.5.1 Extrametricality and Directionality in SNA Foot Formation

Section 5.4.1 established that extrametricality applies to all word-final consonants in SNA. To motivate a word with a peripheral consonant, I refer to the constraint in (44).

- (44). *FINAL-C- μ : “Word-final coda consonants are weightless.” (Prince & Smolensky, 1993, 2004, p. 49).

This constraint stands for extrametricality that applies to peripheral consonants in SNA. As noted in Chapter 2, consonants acquire a mora by virtue of their position in syllable codas, which was postulated by the constraint Weight-by-Position (WBP). If extrametricality is enforced, then *FINAL-C- μ must outrank WBP: *FINAL-C- μ >> WBP. Of course, consonant deletion would be a straightforward way to satisfy *FINAL-C- μ , but this is not attested in SNA. To account for this, *FINAL-C- μ must be dominated by the faithfulness constraint Max-IO: MAX-IO >> *FINAL-C- μ >> WBP (see Table (45)).

(45). *Evaluation of Final CVC Syllables*

CVC	MAX-IO	*FINAL-C- μ	WBP
$\mu\mu$ a. CVC		*!	
μ b. CV	*!		
μ c. CV<C>			*

The evaluation rules out candidate (a) for allowing a final syllable consonant to bear a mora, which incurs a violation of *FINAL-C- μ . Candidate (b), which satisfies *FINAL-C- μ by deleting the final consonant, incurs a fatal violation of MAX-C and is also eliminated. Therefore, candidate (c) is selected as optimal, since it satisfies both *FINAL-C- μ and MAX-IO even though it violates the lower-ranked constraint WBP.

In the case of monosyllabic words, it would appear that extrametricality must not apply; otherwise, the whole word would become unstressed. This scenario was anticipated by Hayes (1995), who proposed the nonexhaustivity constraint in (46).

(46). Nonexhaustivity: “An extrametricality rule is blocked if it would render the entire domain of the stress rules extrametrical.” (Hayes, 1995, p. 58)

This constraint simply means that extrametricality ceases to apply whenever the result is a degenerate foot. Relevant cases include monosyllabic CVC words, as in (47), as well as words

that alternate to CCVC shape due to vowel deletion in the first syllable, as in (48): Non-Exhaustivity >> FINAL-C- μ .

(47). *Evaluation of [gul] ‘Say’*

/gul/	Nonexhaustivity, MAX-IO	*FINAL-C- μ	WBP
a. gu<l>	*! Nonexhaustivity		*
☞ b. (gul)		*	
c. gu	*! MAX-IO		

(48). *Evaluation of [ħfar] ‘Holes’*

/ħfar/	Nonexhaustivity MAX-IO	*FINAL-C- μ	WBP
a. h.fa<r>	*! Nonexhaustivity		*
☞ b. ħ.(far).		*	
c. ħ.fa.	*! MAX-IO		

The tables show that FINAL-C- μ is violable by candidates that preserve the whole domain of stress (the foot). This is illustrated by candidate (b), which is optimal in this evaluation. The Nonexhaustivity constraint eliminates candidate (a) for rendering the entire domain of stress rules extrametrical. As seen in previous tableaux, deleting the final segment violates MAX-IO and therefore eliminates candidate (c).

So far, I have proposed a basic OT mechanism for right peripheral extrametricality in SNA, but I have yet to demonstrate how constraints interact for foot construction and stress assignment. I begin the analysis with constraints in (49) and (50) that dictate foot size.

(49). FT-BIN: Feet must be binary in moraic or syllabic analysis.

(50). PARSE-SYLL: Syllables must be parsed into feet.

Feet in SNA can be ternary in a metrical approach, while a binary approach falls short in accommodating certain constructions, such as HLL and SLL. I reiterate these facts under OT and return to trimoraic syllables in Section 5.5.2.

Starting with the size of feet, FT-BIN must be ranked above PARSE-SYLL (see (51)). Otherwise, I would end up creating feet that are ternary or larger in order to satisfy PARSE-SYLL, which requires each syllable to be footed: FT-BIN >> PARSE-SYLL.

(51). *Evaluation of ['ki.tabt] 'I Wrote'*

/katabt/	FT-BIN	PARSE-SYLL
☞ a. ki(tab)<t>		*
b. (ki.tab)<t>	*	

While candidate (b) satisfies PARSE-SYLL for not leaving any syllable unfooted, it is ruled out because it includes three moras in the foot and therefore incurs a violation against the undominated constraint FT-BIN. Consequently, candidate (a) is the optimal form.

With these basics established, I turn to two sets of constraints that govern stress assignment. The first set pertains to the location of stress within a foot. Kager (1999a) proposed stress is determined by two constraints: IAMB (feet must be iambic) and TROCHEE (feet must be trochaic). Thus, languages that have a trochaic system will rank TROCHEE over IAMB, while languages with an iambic system will rank IAMB over TROCHEE. As I have shown, SNA possesses a trochaic stress pattern, so I can use the following ranking: TROCHEE >> IAMB (see (52)). With this ranking, a head-initial foot is selected over a head-final foot. Consequently, candidate (b) is the optimal form, suggesting each parsed foot has initial stress.

(52). *TROCHEE >> IAMB*

(σ σ)	TROCHEE	IAMB
a. (σ 'σ)	*!	
☞ b. ('σ σ)		*

In Section 5.4.2.2, I noted that SNA favors ('HL) patterns, as ('LH) foot structures (with initial stress on a light syllable) are not attested. Based on the Priority Clause, light syllables can

be skipped during parsing. To rule out such a scenario in OT, I used the constraint in (53) proposed by Prince and Smolensky (2004).

- (53). Weight-to-Stress Principle (WSP) (Prince and Smolensky, 2004, p. 56): Heavy syllables must be prominent in foot structure as well as on the grid.

This principle indicates that heavy syllables should be prominent at the foot and word levels and thus attract stress. This constraint must also dominate PARSE-SYLL: WSP >> PARSE-SYLL. The tableau in (54) shows that foot construction is not only trochaic but also prominence-headed, as in (c). Constructing a trochaic foot with a stressed light syllable violates WSP.

- (54). *Prominence-Headed Foot Construction*

LHL	WSP FT-BIN	TROCHEE	PARSE-SYLL	IAMB
a. ('LH)L	*! WSP			
b. (L'H)L		*!	*	
☞ c. L(HL)			*	
d. (L'HL)	*! FT-BIN	*		*

With this basic outline of how individual feet are constructed, the next step is to handle stress assignment in words with multiple feet. End Rule Right states that stress must be assigned to the rightmost foot. To account for this, I rely on head-foot alignment constraints (Kager, 2007; McCarthy & Prince, 1993) in (55).

- (55). Head-Foot Alignment Constraints:
 a. ALIGN-HEAD-RIGHT (AL-H-R): Align (PrWd, R, Head/PrWd, R): The prosodic word must end with the primary stressed foot.
 b. ALIGN-HEAD-LEFT (AL-H-L) Align (PrWd, L, Head/PrWd, L): The prosodic word must begin with the primary stressed foot.

Since I have shown that stress in SNA is located on the rightmost foot, the constraint in question should be ALIGN-HEAD-R. In other words, AL-H-L has to be dominated by AL-H-R: AL-H-R >> AL-H-L (see (56)).

(56). *AL-H-R* >> *AL-H-L*

(σ σ)	<i>AL-H-R</i>	<i>AL-H-L</i>
☞ a. (σ σ) ('σ σ)		*
b. ('σ σ) (σ σ)	*!	

Ranking *AL-H-R* at the top would render forms like (a) optimal. It would rule out forms as in (b), where the stress is pre-antepenultimate, a pattern not attested in SNA. Thus, this constraint ranking simply implements End Rule Right introduced earlier.

Now that I have established basic constraints for foot construction and stress assignment in SNA, I need to capture the directionality of foot construction in OT terms. In Section 5.4.2, I proposed that SNA has left-to-right construction, i.e., that it builds feet starting from the left edge of the word moving rightwards. According to Kager (1999a), such facts can be captured by the interaction of the two alignment constraints *ALL-FT-L* and *ALL-FT-R* in (57).

- (57). Foot Construction Constraints:
- a. *ALL-FT-LEFT* (*ALL-FT-L*)(Ft, Left, PrWD, Left): Each foot must stand at the left edge of the prosodic word.
 - b. *ALL-FT-RIGHT* (*ALL-FT-R*) Align (Ft, Right, PrWD, Right): Each foot must stand at the right edge of the prosodic word.

These constraints dictate that each foot in a word should be parsed with one edge of the word. Thus, each parsed foot that is not aligned with that edge should trigger one violation mark. These constraints are violable, as words with more than one foot must violate any designated constraint. However, they are indicative of the directionality of parsing. Having established that parsing in SNA is left to right, I rank *ALL-FT-L* above *ALL-FT-R*: *ALL-FT-L* >> *ALL-FT-R*.

For disyllabic words, a single foot will be aligned with both the left and the right edge of the prosodic word; therefore, the ranking of the two constraints does not definitively produce the correct outcome. See the tableau in (58).

(58). *Evaluation of ['ki.tib] 'Has Been Written'*

/katab/	ALL-FT-L	ALL-FT-R
a. ('kiti)		
b. ('kiti)		
c. kitib	*	*

The tableau shows that candidates (a) and (b) are identical on the surface. Assuming that (a) is parsed from left to right and (b) is parsed from right to left leads to the same outcome. As stated earlier, disyllabic forms are not very indicative of directionality in foot parsing. Therefore, trisyllabic words with multiple light syllables can provide a better demonstration of the correct ranking. Because underlying forms with three light syllables typically undergo deletion in SNA, the only options to consider are words with inserted vowels, as exemplified in (59).

(59). *Evaluation of [ʔa.'ʕa.rif] 'I Know'*

/ʔaʕrif/	ALL-FT-L	ALL-FT-R
a. ('ʕa.ʕa.)ri<f>		*
☹ b. ʔa.('ʕa.ri)<f>	*!	

The tableau does not optimize the desired output where stress is on the second syllable as in (b). To motivate foot-initial stress assignment, I can have the actual form only if I have ALL-FT-R outrank ALL-FT-L. Otherwise, I have a form like (a) with the wrong stress marking. It is possible the initial claim that SNA has a trochaic stress pattern was not accurate and SNA should actually be iambic. Alternatively, perhaps parsing should be from right to left. While the former scenario is open for discussion, the latter is challenged by other trisyllabic words which exhibit odd stress location, such as ['mad.ri.sah] 'school.' If footing starts from the left, then the last two light syllables should form a foot and therefore bear stress.

I propose that SNA metrical structures are enforced by additional alignment constraints suggested by McCarthy and Prince (1993) in (60).

- (60). Word Alignment Constraints:
 a. ALIGN-PrWd-L (AL-PrWd-L): Align (PrWd, Left, Ft, Left): Each prosodic word (PrWd) must begin with a foot.
 b. ALIGN-PrWd-R (AL-PrWd-R): Align (PrWd, Right, Ft, Right): Each prosodic word (PrWd) must end with a foot.

Note that these two constraints should not be confused with the foot constraints introduced earlier (ALL-FT-LEFT, ALL-FT-RIGHT). Foot alignment constraints force each foot to be aligned with the prosodic word, whereas word alignment constraints simply require that the beginning or end of the prosodic word coincide with a foot. Thus, the foot alignment constraints assign a violation for each non-initial or non-final foot, depending on the constraint (ALL-FT-LEFT or ALL-FT-RIGHT). In contrast, the word alignment constraints only assign a violation mark if the word does not start or end with a foot.

Since words with more than three syllables in SNA exhibit stress towards the right edge rather than the left, I propose that AL-PrWd-R is the relevant constraint. To derive the correct forms, ALIGN-PrWd-R must dominate the foot alignment constraint ALL-FT-L: FT-BIN, AL-H-R >> AL-PrWd-R, PARSE-SYLL >> ALL-FT-L. In (59), I had trouble predicting the correct stress pattern, which is revisited in (61).

(61). *Evaluation of [ʔa.ʕa.rif] ‘I Know’*

/ʔaʕrif/	FT-BIN	AL-H-R	AL-PrWd-R	PARSE-SYLL	ALL-FT-L
a. (ʕa.ʕa.ri)<f>	*!				
b. ʔa(ʕa.ri)<f>				*	*
c. (ʔa.ʕa).ri<f>			*!	*	
d. ʔa.ʕa.ri<f>			*!	***	*

With the introduction of AL-PrWd-R, I can still adhere to a trochaic stress system given that ALL-FT-L is dominated by AL-PrWd-R. The latter forces words to end with a foot. Even though (b) and (c) equally violate PARSE-SYLL, to satisfy the undominated constraint FT-BIN,

the form (b) is the optimal candidate for satisfying the AL-PrWd-R constraint. Candidate (d) is ruled out for multiple violations of AL-PrWd-R and PARSE-SYLL.

This section introduced extrametricality with the constraint *FINAL-C- μ and investigated the directionality in foot construction in SNA. It considered two scenarios, but only left to right appears adequate by stipulating a constraint that aligns all feet to the left of the word, ALL-FT-L. With respect to words in the shape LLL with penultimate stress, I incorporated word alignment, which requires the right edge of a word to coincide with a foot, i.e., L(LL).

5.5.2 Maximal Footing in SNA

Thus far in the OT analysis, I have used the FT-BIN constraint, which states that feet may contain a maximum of two moras. This section reinforces that a ternary foot construction is not only advantageous but necessary to account for the stress patterns in SNA. Below, I return to a problematic case introduced earlier with binary approaches, i.e., words with the shape HLL, e.g., [‘mad.ri.sah] ‘school.’ Such words have stress on initial heavy syllables, even though I established the word alignment constraint is right-edged. The tableau in (62) shows how these constraints interact.

(62). *Evaluation of [‘mad.ri.sah] ‘School’*

/madrasah/	FT-BIN AL-H-R	AL-PrWd-R	PARSE-SYLL	ALL-FT-L
a. (‘mad)(risa)<h>	*! AL-H-R			
☹ b. (mad)(‘risa)<h>				*
c. (‘mad.ri).sa<h>	*! FT-BIN		*	
d. (‘mad)risa<h>		*!	**	

If parsing was from right to left, words like (b) should be the optimal form given that the first two syllables form a binary foot. This would cause stress to be on the final foot, an undesired location. Ranking ALL-FT-R over ALL-FT-L does not solve the problem, given that

the actual output is (c). In other words, the word [madirsah] cannot be motivated solely by directionality of footing.

The goal then is to establish a mechanism that derives (a) without neglecting all the ranking introduced so far. To overcome this obstacle, I considered a trimoraic foot construction. Section 5.4.2 showed that under specific circumstances, feet are trimoraic. That is, feet of the shape HL are permitted, which conforms with the general trochaic pattern I have proposed for SNA. Some languages build ternary recursive feet as a last resort to adhere to exhaustivity (i.e., each syllable must be footed). These languages include Tripura Bangla (Das, 2001), Cayuvava (Key, 1961, 1963), Wargamay, Yidj, and Chugach (Martínez-Paricio, 2013). However, I cannot claim exhaustivity is the motivation for recursive feet parsing in SNA, as some syllables may remain unfooted. For instance, the first syllable of [gi.('di:m)] 'old' is not parsed under a foot. Instead, I argue that recursive foot parsing in SNA is a mechanism to adhere to one general constraint, economic parsing. Economic parsing claims that words tend to be parsed with a minimum number of feet: the fewer the feet, the fewer overall violations of foot and word-alignment constraints.

The concept of economic foot parsing is not exclusive to SNA. For instance, Martínez-Paricio (2013) reported that Chugach favors recursive foot parsing in even-parity (forms with an even number of syllables) with the fewest feet. But in an output-oriented framework such as OT, what constraints would favor recursive feet instead of binary feet? One strategy would be to modify the FT-BIN constraint so that it accommodates trimoraic feet. Alhuwaykim (2018) made a similar suggestion for Northwestern Saudi Arabic in (63).

- (63). FT-BIN (Revised): FT-BIN/MAX
- a. Feet are minimally binary under moraic analysis.
 - b. Feet are maximally trimoraic and disyllabic.

With this modification, trimoraic feet are now permissible. The first part of the constraint indicates that feet cannot be constructed without the minimum weight requirement, which is two moras. The second part states that a foot's maximum weight is three moras, whether it is disyllabic (HL) or monosyllabic (S). However, a trisyllabic foot is not possible, i.e., *(LLL). The interaction of the revised FT-BIN constraint with a new proposed constraint can enforce maximal parsing, as stated in (64).

(64). FT-TRI: Assign one violation for each binary foot under moraic or syllabic analysis.

This constraint enforces maximal footing when possible. In other words, each minimal/binary foot is assigned a violation mark. For instance, the word (mad)(risa<h>) is assigned one violation by FT-TRI, whereas the same word when parsed with one maximal foot [(mad.ri)sa<h>] is not. In order to enforce maximal parsing into an ('HL)L pattern instead of (H)('LL), FT-TRI must dominate AL-PrWd-R and PARSE-SYL. Additionally, to avoid leaving heavy syllables unparsed to satisfy FT-TRI, I can involve the constraint in (65).

(65). $\sigma\mu\mu=FT$: Assign a violation mark for each bimoraic syllable that does not coexist with a foot (Hewitt, 1994; Kager, 1993; Martínez-Paricio, 2013; Prince, 1980; Rice, 1992)

This constraint ensures that each heavy or superheavy syllable is parsed under a foot. FIT-TRI must be dominated by $\sigma\mu\mu$, as heavy syllables cannot be left unfooted. All of the considerations so far yield the following ranking: FT-BIN/MAX, $\sigma\mu\mu=FT$, AL-H-R >> FT-TRI >> AL-PrWd-R, PARSE-SYL >> ALL-FT-L.

(66). *Evaluation of ['mad.ri.sah] 'School'*

/madrasah/	FT-BIN/MAX, WSP, $\sigma\mu\mu=FT$,AL-H-R	FT- TRI	AL- PrWd-R	PARSE -SYL	ALL- FT-L
a. ('mad.ri.sa)<h>	*! FT-BIN/MAX		*		
b. (mad)(risa)<h>		**			*
☞ c. (mad.ri)sa<h>			*	*	
d. mad.(ri.sa)<h>	*! $\sigma\mu\mu=FT$	*		*	*
e. (mad.'ri) sa<h>	*! WSP		*	*	

The evaluation in (66) illustrates why a form like (c) is optimal. Candidate (a) fatally violates the undominated FT-BIN/MAX, so it is ruled out. Candidate (b) incurs a double violation of FT-TRI, one for the bimoraic foot (mad) and another for the bimoraic foot (ri.sa). Candidate (d), in addition to violating FIT-TRI for the bimoraic foot (risa), violates the fatal constraint $\sigma\mu\mu=FT$ for leaving a heavy syllable unfooted. Candidate (e) is also eliminated for parsing the correct foot but stressing the second leg, which is less prominent, i.e., a light syllable. As a result, candidate (c) is optimal.

One could suggest that all of these constraints are not necessary and that maximal foot parsing is not the only solution for SNA. As noted in Section 5.4.2.1, an alternative would be to propose that SNA has a weak parsing system, which separates feet from one another by leaving some light syllables unfooted. In the case of the word [(mad)risah], for example, the first foot would be parsed, and then a light syllable would be left unparsed to avoid adjacent feet. This would leave the final syllable unfooted as well. In this analysis, stress would be placed on the antepenult and the correct form would be derived. While this perspective may have some advantages, forms such as [ka:t.'bitih] ‘she has written it/him’ would remain puzzling. In such words, the last two syllables have to form a foot, as in [(ka:t.)('bi.ti<h>)], or else stress would be outside a metrical foot: [(ka:t.)'bi.ti<h>]. Each would be problematic for this alternative view. My analysis, on the other hand, shows that stress assignment in SNA, for this word and others, depends on a tendency toward economic parsing by having the fewest possible feet. This theory is tested on the word [ka:t.'bi.tih] in (67).

(67). *Evaluation of [ka:t.'bi.tih] ‘She Has Written It/Him’*

/ka:tbat-ih/	FT-BIN/MAX, $\sigma\mu\mu=FT$, AL-H-R	FT- TRI	AL- PrWd-R	PARSE -SYL	ALL- FT-L
a. ('ka:t.bi).ti<h>	*! FT-BIN/MAX		*	*	*
b. ka:t.('bi.ti)<h>	! $\sigma\mu\mu=FT$	*		*	*
c. ('ka:t)biti<h>			*!	**	
d. ('ka:t.)(biti)<h>	*! AL-H-R	*		**	
e. (ka:t)('biti)<h>		*			*

When I parse a superheavy plus light syllable, the outcome is a foot with four moras, which triggers a violation of FT-BIN/MAX in candidate (a). Alternatively, leaving the superheavy unfooted to derive a word with penultimate stress fatally violates $\sigma\mu\mu=FT$ in (b). Footing the first syllable but leaving the last two light syllables unfooted, as in (c), incurs a fatal violation of AL-PrWd-R and PARSE-SYL. Candidate (d) incurs a violation of AL-H-R for stressing the leftmost foot. Consequently, candidate (e) is the optimal form because it constructs a recursive maximal foot followed by a minimal foot, even if this incurs one violation of FT-TRI.

In multisyllabic words with adjacent heavy syllables, recursive foot construction into an (HH) structure would not be available because such forms would violate FT-BIN/MAX. Recursive construction can only apply to superheavy syllables or to a sequence of heavy and light syllables (HL). In (68), I show the derivation for a word with an SHL shape.

(68). *Evaluation of [ka:t.'bat.hum] ‘Their Female Writer’*

/ka:tbathum/	FT-BIN/MAX $\sigma\mu\mu$, AL-H-R	FT- TRI	AL- PrWd-R	PARSE- SYL	ALL- FT-L
a. ka:t.('bat.hu)<m>	*! $\sigma\mu\mu=FT$			*	*
b. (ka:t)('bat.hu)<m>					*
c. (ka:t.'bat)hu<m>	*! FT-BIN/MAX		*	*	*
d. (ka:t)('bat)hu<m>		*!	*	*	*

Candidate (a) exhibits the correct stress placement but leaves a heavy syllable unparsed, a violation of $\sigma\mu\mu$. Over-parsing, on the other hand, gives rise to forms exceeding the maximal weight, such as candidate (c), which violates FT-BIN/MAX. Consequently, (b) is selected as the

optimal form. Although it shows the correct stress, Candidate (d) is ruled out since it violates FT-TRI for not parsing a maximal second foot.

So far, I have shown that parsing feet with the maximal weight is preferred even in cases where the top-ranked constraints are not violated. This preference is also enforced by lower-ranked alignment constraints. The tableau in (69) shows the derivation of a word with the shape HLH.

(69). *Evaluation of [ba:.ri.'bat.lih] 'She Congratulated Him'*

/ba:ra.kat.lih/	FT-BIN/MAX σμμ AL-H-R	FT-TRI	AL-PrWd-R	PARSE-SYL	ALL-FT-L
a. (ba:)ra(kat)li<h>		*!*	*	**	
b. ba:ri.(['] kat.li)<h>	*! σμμ			**	*
c. c. (ba:.ri)(['] kat.li)<h>					*
d. (ba:.)ri.(['] kat.li)<h>		*!*	*	*	*
e. (ba:.)ri.(['] kat.li)<h>		*!		*	*

This tableau shows how recursive feet parsing also respects general conditions, namely the exhaustivity condition, represented by PARSE-SYL, and the prosodic word alignment, represented by AL-PrWd-R.

Before we conclude this chapter, we need to go back to one issue described earlier, particularly final CVG that does not bear stress even when preceded by a light syllable, e.g., /jimidd/, due to degemination in SNA. The same premise should hold true for CVVG syllables, e.g., /ra:dd-lih/ > [ra:d.lih]; otherwise, I would have to make an exception for what seems to be a non-final tetramoraic syllable. For final geminates, I hypothesize the constraint in (70).

(70). *GEMINATE]_# (GEM]_#): A geminate consonant is not allowed word-finally.

This constraint enforces all geminate consonants to reduce to singleton consonant in word-final position. Therefore, an underlying final CVG should behave like CVC, which undergoes extrametricality (see (71)).

(71). *Underlying Final CVG Behaves Like CVC*

/ji.fidd/	FT-BIN/MAX σμμ, WSP AL-H-R, GEM]#	FT- TRI	AL- PrWd-R	PARSE -SYL	ALL- FT-L
a. (ʃi.fid)<d>	*! GEM]# *! WSP				
b. ji. (ʃid)<d>	*! GEM]#	*		*	
c. (ʃi.ʃi)<d>		*			

The addition of this constraint justifies the behavior of a final CVG. In Table 94, Candidate (a) is eliminated for not reducing the geminates and for violating the constraint WSP, which forces heavy syllables to take stress. Candidate (b) also triggers a violation of GEM]#. Candidate (c) is thus selected as optimal, even though it is not a maximal foot.

This section explained the representation of trimoraic feet in SNA within OT. It showed that SNA foot construction follows an economic preference for less footing. This was achieved by the constraints σμμ and FT-TRI, which are crucial for an OT analysis of stress and foot construction. If I did not include σμμ and instead pursued an analysis based on minimal parsing, there would be no motivation to stress the first syllable in HLL words, e.g., *mad('rishah). Eliminating the constraint FT-TRI would give rise to a similar problem, i.e., *(mad)('rishah). Based on these observations, these constraints are not only useful for my analysis but necessary to produce the desired output. Finally, I explained the stress interaction of word-final geminates and proposed a constraint that militates against them. With this constraint, a final geminate reduces to a singleton segment, and through extrametricality, a CVG acts like a light CV syllable.

5.6 Conclusion

This chapter analyzed stress patterns and foot construction in SNA from a metrical and OT perspective. It showed SNA has a quantity-sensitive stress system in which stress assignment

is restricted to the last three syllables and depends on the weight of the syllable. The chapter also showed that word-final consonants undergo extrametricality. This extrametricality appears to be a general pattern that applies not just to CVC syllables, as has been reported for many Arabic dialects, but to all syllable types.

In Metrical Theory, stress in SNA is dependent on foot construction. Within a foot, the leftmost element is stressed, showing a trochaic pattern. In words with multiple feet, the rightmost foot gets stressed, enforced by End Rule Right. Trimoraic feet appear to exist in SNA for two reasons. First, trimoraic feet can account for superheavy CVVC, CVVG, and CVCC syllables in non-final position. This was demonstrated by adopting recursive branching at the foot level so that a peripheral mora can adjoin to a preceding foot at a higher foot node. Second, trimoraic feet can account for the antepenultimate stress on heavy syllables in HLL words.

Finally, this chapter analyzed these proposals within an OT framework. It showed that extrametricality is encapsulated by the constraint *FINAL-C- μ , which is violable in monosyllable words, where mora extrametricality affects the whole domain of stress. For foot construction, a foot can be binary or ternary, with a trochaic pattern enforced by the top-ranked constraint TROCHEE. The preference to construct trimoraic feet was interpreted as an economic move to parse words with the fewest feet possible. This tendency was modeled with the interaction of three constraints: FT-BIN/MAX, preserving minimal and maximal parsing, and FT-TRI, which enforces trimoraic foot parsing. The interaction of these constraints also explains apparent discrepancies where stress occurs on the antepenultimate syllable in ((H)L)L words but on the penult in ((S))('LL) words.

Chapter 6: Post-Lexical Phonology in SNA

6.1 Introduction

The previous chapter examined the stress patterns in SNA from the perspectives of Metrical Theory and OT. While most stress patterns were straightforward to analyze, some posed challenges, such as antepenultimate stress in ('HLL) structures versus penultimate stress in (S'LL) structures. With the stipulation of recursive foot and maximal foot constructions, these difficult patterns were resolved. However, not all puzzling patterns have been explained in SNA. This chapter sheds light on aspects of SNA phonology that seem to give rise to opaque structures. These structures are induced by the interaction of stress and other phonological processes, namely vowel epenthesis and vowel raising.

The first half of the chapter illustrates epenthesis due to SSP and epenthesis due to complex consonant clusters. Since these types of epenthesis induce opaque stress assignment, I propose that they must occur at the post-lexical level, where the stress application has already been manifested. After that, I discuss a related phenomenon, the underapplication of vowel raising (or vowel reduction as explained by Reduce) in forms where SSP-related epenthesis has been applied.

6.2 Vowel Epenthesis in CVCC Syllables

In several Arabic dialects, epenthesis occurs before the last consonant in monosyllabic CVCC words, such as /gabl/ > [gabil] 'before' and /ʔakl/ > [ʔakil] 'food.' This vowel insertion is regulated by SSP. According to Kiparsky (2003), so-called C dialects do not allow coda clusters with a rising sonority at the syllable boundary and repair such clusters by inserting a vowel between consonants to break up the cluster. Ingham (1994) reported a similar analysis for Najdi Arabic, and Kenstowicz (1986) found that word-final clusters in monosyllabic CVCC words

were tolerated in Bedouin Jordanian Arabic, as long as SSP was not violated. Otherwise, epenthesis was required to break up the cluster; e.g., /ħiml/ ‘load’ would be released as /ħimil/. Similarly, Abdul-Karim (1980) reported that vowel epenthesis in Lebanese Arabic in coda clusters of CVCC words was obligatory only when the coda had a rising sonority. These patterns are further exemplified in the following data from SNA in (1).

(1).	a. /bint/	[bint]	‘daughter’
	b. /ħilm/	[ħilm]	‘dream’
	c. /sabt/	[sabt]	‘Saturday’
	d. /dars/	[dars]	‘lesson’
	e. /zurg/	[zurg]	‘blues’
	f. /gurb/	[gurb]	‘oncoming’
	g. /miθl/	[miθil]	‘like’
	h. /ħiml/	[ħimil]	‘load’
	i. /ʕasr/	[ʕasir]	‘squeezing’
	j. /gabl/	[gabil]	‘before’
	k. /wadʒh/	[wadʒih]	‘face’
	l. /ħumr/	[ħumur]	‘reds’
	m. /ʃukl/	[ʃukul]	‘plural of one type of palm tree dates’

In (1a-f), the forms’ surface show no change because sonority in the coda cluster falls towards the edge of the prosodic word. When the coda clusters violate SSP, as in (1g-m), epenthesis takes place as a repair strategy.

In SNA, one obstacle that arises with such forms is stress. Specifically, when further affixation takes place on the stems in (1a-f), the resulting stress pattern appears opaque. Example (2) examines the same dataset as (1g-m) with suffixes attached to the stem.

In (2a-c), epenthesis does not occur because the suffix is vowel-initial, which allows the last consonant of the stem to re-syllabify as the onset of the following vowel. The resulting syllable pattern is HL (the final syllable is light due to an extrametrical consonant), with stress on the penultimate syllable, as expected. In (2d-g), however, epenthesis does occur. This is because the suffix is consonant-initial, so the grammar must still repair the illicit coda cluster at the end

of the first syllable. The resulting syllable pattern is LHL. Puzzlingly, stress occurs on the antepenultimate syllable, a pattern that is not attested in SNA, except with these forms.

- | | | | |
|------|---------------|---------------|--------------------------|
| (2). | a. /miθl-ih/ | ['miθ.lih] | ‘like’ |
| | b. /ħiml-ih/ | ['ħim.lih] | ‘load’ |
| | c. /ʕasr-ih/ | ['ʕas.rih] | ‘squeezing’ |
| | d. /gabl-kum/ | ['ga.bil.kum] | ‘before you (plural)’ |
| | e. /wadʒh-ha/ | ['wa.dʒih.ha] | ‘her face’ |
| | f. /ħumr-hum/ | ['ħu.mur.hum] | ‘their reds’ |
| | g. /ʃukl-na/ | ['ʃu.kul.na] | ‘our dates’ ⁹ |

Cross-linguistically, epenthetic vowels do not behave regularly when they interact with stress (Alderete, 1999, p. 2). While such vowels are ignored by stress in certain syllables, they undergo stress patterns in others. This observed behavior is attested in SNA. In the data in (2d-g), the stress algorithm appears to ignore the epenthetic vowel, i.e., to operate on the pre-epenthetic syllable structure, SL. In other instances, the stress algorithm in SNA appears to incorporate the epenthetic vowel. Chapter 3 analyzed a process of low-vowel epenthesis that occurs after a preconsonantal guttural consonant that follows a low vowel. This epenthetic low vowel is counted in stress, as exemplified in (3).

- | | | |
|------|--------------------------------|--|
| (3). | a. /taħt/ → ['taħat] ‘below’ | /taħt-hum/ → [ta'ħathum] ‘below them’ |
| | b. /saʕʔd → ['saʕad] ‘fortune’ | /saʕd-kum/ → [sa'ʕadkum] ‘your (plural) fortune’ |
| | c. /ʃahr/ → ['ʃahar] ‘month’ | /ʃahr-na/ → [ʃa'harna] ‘our month’ |

The dataset shows that when a low vowel is inserted, it may attract stress if it falls in the right environment. There appear to be two different types of phenomena, and the fact that one type of epenthesis is invisible to stress (2d-g) while the other is not (3) suggests they apply at different stages.

⁹ The term ['ʃu.kul] refers to one type of dates from a particular palm tree.

The examples in (2) do not exhibit opacity only in stress. They also show an underapplication of another process, Reduce: [a] > [i], [u] > Ø. Given the conditioning factors for Reduce, I would expect underlying /a/ to be reduced to /i/ and underlying /i, u/ to be deleted, e.g., /gabl-kum/ > *[gi.bil.kum] or /ʃukl-na/ > *[ʃkulna]. Thus, these forms show a “double-opaque” behavior with non-surface-true forms for stress assignment and for Reduce.

Cases of Reduce opacity are not unique to SNA, as others have reported vowel raising underapplies in many Bedouin Arabic dialects (e.g., Al-Mozainy, 1981; Johnstone, 1967; McCarthy, 1999) when interacting with vocalization, another process that targets glides in word-final position: [j] > [i], [w] > [u]. Traditional analyses of opaque forms rely on rule-ordering, which produces intermediate forms. McCarthy (1999) admitted that opacity poses a challenge for an output-driven OT approach, in which serial steps and intermediate forms are not available. These problems led some to question the validity of OT as a framework (e.g., Archangeli & Suzuki, 1996, 1997; Black, 1993; Goldsmith, 1996; Halle & Idsardi, 1997; Idsardi, 1998; Jensen, 1995). In the following section, I examine approaches to opacity in general, concluding that the framework of lexical phonology, expressed in OT terms using Stratal OT, is the superior approach.

6.3 Opacity and Stress

Opaque stress has been discussed in the literature of Arabic dialects for decades. The problem was first addressed by Brame (1974) on Palestinian Arabic, which exhibits opaque stress when interacting with syncope. Similar patterns have been reported for Levantine Arabic (e.g., Abu Mansour, 1987, 1995; Bakalla, 1973, Farwanah, 1995; Ingham 1971; Kenstowicz & Abdul-Karim, 1980), Syrian Arabic (e.g., Abu-Salim, 1980,1982; Adra, 1999), Makkan Arabic (e.g., Kabrah, 2004; Kager, 1999a, 1999b; Kiparsky, 2000, 2003), and Ruwaili Arabic (e.g., Al-

Solami, 2020; Watson, 2007). Despite this, no previous work to my knowledge has described cases of double opacity, as in SNA.

In a rule-based approach, epenthesis and stress interactions are generally analyzed with rule ordering. Essentially, if an epenthetic vowel is visible to stress patterns, epenthesis occurs prior to stress rules. Conversely, when epenthesis is invisible to stress patterns, epenthesis occurs after stress rules. I could suggest that the underapplication of vowel raising or high vowel deletion (Reduce) is explained by the same logic. Using the data from (2), which exhibit epenthesis driven by SSP, a sample derivation is shown in (4) (cf. Kenstowicz, 1994, p. 272). In (4), stress assignment is ordered before epenthesis. This accounts for the fact that vowels inserted by SSP-driven epenthesis are invisible to stress.

- (4). a. The derivation for ['ga.bil.kum] 'before you (plural)'
- | | |
|---------------|--|
| / gabl-kum/ | Input |
| /gabl.kum/ | Syllabification |
| _____ | Reduce: Vowel Raising or High Vowel Deletion |
| /'gabl.kum/ | Stress Assignment |
| /'ga.bil.kum/ | Epenthesis and Re-Syllabification |
| ['ga.bil.kum] | Output |
- b. The derivation for ['mi.θil.hum] 'like them'
- | | |
|---------------|--|
| /miθl-hum/ | Input |
| / miθl.hum/ | Syllabification |
| _____ | Reduce: Vowel Raising or High Vowel Deletion |
| /'miθl-hum/ | Stress Assignment |
| /'mi.θil.hum/ | Epenthesis and Re-Syllabification |
| ['mi.θil.hum] | Output |

In OT models, several works have dealt with opacity in general and stress in particular. One of the earliest models was FILL/PARSE theory (Prince & Smolensky, 1991, 1993). Here, syncope is enforced by unparsed segments, whereas epenthesis is enforced by underlying empty positions. Under this analysis, the underlying representation of coda consonants that do not meet SSP contains an empty form, e.g., [miθ_l]; to satisfy the FILL constraint, insertion is required.

However, this approach does not have a mechanism to solve the problem that the inserted vowel remains invisible to stress, nor does it address the “double opaque” problem, in which Reduce underapplies in epenthetic forms.

Other accounts have proposed that epenthetic vowels have a special status. For example, one approach assumes epenthetic syllables have a defective prosodic structure that affects the assignment of stress (e.g., Broselow, 1982, 1992; Farwanah, 1995; Piggott, 1995). Alderete (1999) suggested that universal grammar contains the faithfulness constraint HEAD-DEP that requires stressed vowels in output forms to have input correspondents. Consequently, epenthetic vowels cannot be stressed. In a slightly different approach for Syrian Arabic, Adra (1999) proposed that stress should be matched across paradigms, with unaltered stems serving as the base forms. However, even if these approaches offer a solution to the interaction of epenthesis and stress, they cannot account for the SNA interaction of epenthesis and Reduce.

Kiparsky’s (2003) semisyllable account provided another, more interesting argument for opaque stress induced by epenthetic vowels. According to Kiparsky, the observed invisibility of vowels in many Arabic dialects is due to them being epenthesized post-lexically, that is, after all other stem- and word-based phonological processes have been applied. His observation was that epenthetic vowels undergo stress in one dialect group, known as CV dialects, but are invisible to stress in the two other groups, VC and C. This strongly suggests epenthesis is taking place at different levels, depending on the dialect.

Kiparsky’s (2003) main argument is that, in CV group, a semisyllable in the string CVC.C is not permissible at the lexical level (i.e., stem and word). Therefore, epenthesis occurs at the post-lexical level in these dialects, and epenthetic vowels consequently follows stress rules. In VC and C dialects, however, the semisyllable is allowed at the lexical level but not at

the post-lexical level. Therefore, vowel insertion occurs post-lexically after all other lexical processes, including stress assignment, have been applied. For this reason, stress opacity is seen in these dialects.

Having established that SNA is a potential C dialect, I follow Kiparsky's (2003) approach and offer three arguments that SSP-induced epenthesis is applicable at the post-lexical level in SNA. The first argument is that stress in SNA is lexical, as established in Chapter 5. In other words, stress assignment occurs at both the stem and the word level and is influenced by the morphological structure of the word. This is best demonstrated by the fact that when affixation takes place, stress is reassigned. The data in (5) show that morphological affixation alters stress assignment, indicating it is a lexical process.

(5).	a. /katab/	['kitab]	'he wrote'
	b. /kitab-ha/	[ki.'tab.ha]	'he wrote it (f)'
	c. /katabat/	[kti.bat]	'she wrote'
	d. /ktibat-hum/	[kti.'bat.hum]	'she wrote them'
	e. /ka:tib-ah/	['ka:t.bah]	'female writer'
	f. /ka:tibat-hum/	[ka:t.'bat-na]	'our female writer'
	g. /maktabah/	['mak.ti.bah]	'library'
	h. /maktibat-kum/	[mak.ti.'bat.kum]	'your (plural) library'

The second argument is found in other types of epenthesis in the dialect, particularly post-guttural epenthesis. As shown earlier, epenthesis induced by SSP and epenthesis induced by guttural sequences must be distinguished from one another. Interestingly, the post-guttural epenthesis does not give rise to opaque stress patterns, even if the underlying form violates SSP. In terms of rule ordering, the data in (6) suggest that SSP epenthesis is counterfered by post-guttural epenthesis.

- | | | | | | | |
|------|-----------|----------|----------|------------|---------------|---------------|
| (6). | a. /baħr/ | ['baħar] | ‘sea’ | /baħr-kum/ | [ba.'ħar.kum] | ‘your sea’ |
| | b. /fahr/ | ['fahar] | ‘month’ | /fahr-hum/ | [fa.'har.hum] | ‘their month’ |
| | c. /baʕl/ | ['baʕal] | ‘mule’ | /baʕl-na/ | [ba.'ʕal.na] | ‘our mule’ |
| | d. /ʔahl/ | ['ʔahal] | ‘family’ | /ʔahl-ha/ | [ʔa.'hal.ha] | ‘her family’ |

The third argument comes from a third type of SNA epenthesis that only occurs in CCCC sequences at the phrase level. That is, whenever a string of words produces a CCCC sequence, a vowel is inserted to break up this sequence, CCiCC. This epenthesis leads to re-syllabification and opaque stress, as in (7).

- | | | | |
|------|-------------------|-------------------|-----------------------------|
| (7). | a. /katabt-l-hum/ | [kitab.til.hum] | ‘I wrote for them’ |
| | b. /radʒaʕt-l-ha/ | [ri.'dʒaʕ.til.ha] | ‘I came back for her!’ |
| | c. /ʕift-l-kum/ | [ʕif.'til.kum] | ‘I looked for you (plural)’ |

Example (7) shows that whenever a complex coda is followed by two consonants, the vowel /i/ is inserted to break up this sequence. Note that no such epenthesis occurs when CCC sequences are created by affixation: /katabt-l-ih/ [ki.'tabt.lih] ‘I wrote for him.’ When this phrase-level epenthesis occurs, the penultimate syllable becomes heavy; nonetheless, it does not attract stress. This pattern is similar to epenthesis induced by SSP. Since phrasal phonology is by definition post-lexical, this data supports the idea that SSP epenthesis is also post-lexical.

The fact that this epenthesis is also found at the phrase level supports the claim that epenthetic vowels that are invisible to stress occur at the post-lexical level. One could argue that phrasal epenthesis in (7) is induced by the Syllable-Contact Law, which requires sonority to fall from the coda of one syllable to the onset of the next. Given that the consonant cluster is followed by a more sonorous sound /l/, e.g., in [ʕift.l.kum] ‘I looked for you (plural),’ a vowel is inserted to conform to the law. Such a claim, however, should be rejected for two reasons. First, as pointed out earlier, SNA does not generally conform to the Syllable-Contact Law. There are plenty of words in which sonority rises from the coda of one syllable to the onset of the next, e.g., [madʒ.liʕ] ‘guest room’ and [jat.ruk] ‘he leaves.’ Second, the epenthesis at the phrase level

occurs even in cases where no repair is needed, i.e., when there is no rise from a coda consonant to the following onset consonant.

- (8). a. /ruħt-b-hum/ [kitab.tɪb.hum] ‘you took them with you?’
 b. /radʒaʕt-b-ha/ [ri.'dʒaʕ.tɪb.ha] ‘I came back with her!’
 c. /ʃift-b-ha/ [ʃif.tɪb.ha] ‘I saw with it (f)’

Unless a sonority plateau is not tolerated in SNA, these forms cast doubt on the argument that sonority is the motivation for epenthesis in complex margins. Interestingly, phrasal epenthesis of this type can replace epenthesis induced by SSP. This is illustrated in (9).

- | | | | | | |
|------|----------------------|----------------|-----------------------|---------------------------|-------------------------|
| (9). | In Isolation | | | In Phrase with /il/ ‘the’ | |
| | a. [ʔisim] ‘name’ | [ʔilwalad] | ‘the boy’ | [ʔis.mil.wa.lad] | ‘the boy’s name’ |
| | b. [dʒibin] ‘cheese’ | [ʔil.ma.ra:ʕi] | ‘Marai’ ¹⁰ | [dʒib.nil.ma.ra:ʕi] | ‘Marai cheese’ |
| | c. [gabil] ‘before’ | [ʔilba:riħ] | ‘last night’ | [gab.lil.ba:riħ] | ‘the other night’ |
| | d. [ħumur] ‘reds’ | [ʔil.ʕju:n] | ‘eyes’ | [ħum.rul.ʕju:n] | ‘the red-eyed (plural)’ |

These observations on different phenomena of epenthesis reveal that opacity in stress application and Reduce are only justifiable if the concept of post-lexical phonology is adopted.

6.4 Other Potentially Opaque Surface Structures

Previous sections shed light on the opacity problem in SNA, particularly in forms with opaque stress patterns. In this section, I present datasets that develop the analysis of opacity in the underapplication of Reduce.

As described in Chapter 1, Reduce applies to vowels in open syllables such as /katab/ > /kitab/ ‘he wrote’ but never occurs in close syllables: /maktab/ > [maktab] ‘office.’ Nonetheless, there are disyllabic CVCVC forms that are faithful to their underlying representation, in which Reduce does not seem to apply, as in (10).

¹⁰ Marai (literally “pastures”) is the name of a large dairy company in Saudi Arabia.

In each of these words, the first /a/ remains intact, suggesting Reduce has been underapplied for some reason. Even more problematic, the final /i/ does not delete either, even though a final high vowel in disyllabic verbal and adjectival forms generally gets deleted.

Compare the data in (10) with the (11).

- | | | | |
|-------|-------------|----------|------------------------------|
| (10). | a. /θagil/ | [θagil] | ‘got heavy’ |
| | b. /gabil/ | [gabil] | ‘he accepted’ |
| | c. /dʒamil/ | [ʒamil] | ‘he did a favor’ |
| | d. /nadim/ | [nadim] | ‘he regretted’ |
| | e. /waθir/ | [waθir] | ‘he has to’ |
| | f. /kabil/ | [kabil] | ‘it/he got big’ |
| | g. /sʰakir/ | [sʰakir] | ‘it/he got small’ |
| | | | |
| (11). | a. /salim/ | [salm] | ‘he survived/recovered from’ |
| | b. /ʃarib/ | [ʃarb] | ‘he drank’ |
| | c. /garib/ | [garb] | ‘it/he became close’ |
| | d. /nadʒis/ | [nadʒs] | ‘filthy’ |
| | e. /ħarik/ | [ħark] | ‘very active’ |
| | f. /galig/ | [galg] | ‘very concerned’ |

The words in (10) have the same underlying shape as those in (10), CVCiC. However, the words in (11) undergo a final /i/ syncope. Given that that the initial vowel [a] gets syllabified in a closed syllable, it does not undergo Reduce. Thus, words in (10) are peculiarly counterexamples to two processes. First, they seem to be blocking the final syllable high vowel from syncope. Second, they also block the first vowel from raising.

Alternatively, I could propose that forms in (10) do not actually show exceptionality to the general process but rather show abstractness, as the final consonant is more sonorous than the preceding consonant. But what does SSP have to do with opacity in these forms? The answer can be inferred if I assume that final /i/ gets deleted and then a similar vowel is inserted at a later stage, with each process driven by a different motivation. First, syncope takes place to follow the usual pattern at the lexical level, and then epenthesis occurs due to SSP at the post-lexical level. Reduce is not violated lexically given that syncope would lead to a CVCC form where the vowel

does not have to raise. Similarly, this helps explain why the final /i/ is not deleted because it is simply a different vowel. Thus, surface forms should not be treated as exceptions. This hypothesis is summarized in (12).

(12).	Underlying representation:	/salim/	/ʃarib/	/θagil/	/gabil/
	Lexical processes:				
	Reduce/Final /i/ syncope:	/salm/	/ʃarb/	/θagl/	/gab/
	Post-lexical processes				
	SSP:			/θagil/	/gabil/
	Output:	[salm]	[ʃarb]	[θagil]	[gabil]

Assuming final /i/ syncope is applicable every time unless more complex structures emerge, i.e., three consonant clusters CCC, Reduce is not violated in all the examples. If the result is a cluster with a rise in sonority, then epenthesis takes place at the post-lexical level just as in [θagil] and [gabil].

Another set of forms that show underapplication of Reduce concerns the vocalization process. In many Bedouin dialects, SNA included, a final glide turns into a vowel if it occurs word-finally. Although the process has been described in different ways, e.g., as sonority reversal by Kabrah (2004) and vocalization by McCarthy (1999), there is agreement that a word-final underlying glide surfaces as a corresponding vowel, as in (13).

(13).	a. /majj/	maji	‘walking’	/majjah/	[majjah]	‘way of walking’
	b. /ramj/	[rami]	‘throw’	/ramjah/	[ramjah]	‘a throw’
	c. /badw/	[badu]	‘Bedouins’	/bada:wah/	[bida:wah]	‘Bedouinism’
	d. /dzibw/	[dzibu]	‘bulky’	/dzibw/	[dzibu]	‘bulky (f)’

The underapplication of Reduce in these examples indicates that vocalization must occur at the post-lexical level.¹¹ While investigating the process itself was beyond the scope of this study, I shed light on the opaque stress involved in this process.

¹¹ It is possible that epenthesis here is driven by SSP in the first place and then a final glide is deleted. The challenge in this interpretation is that these processes must be in a serial order, yet both need to be post-lexical.

This section investigated multiple types of epenthesis-induced opacity in SNA. Some forms exhibit opacity associated with stress location or underapplication of vowel raising (or deletion), while some forms show both types of opacity (SSP-driven epenthesis). Comparing these SSP vowel insertions with other types of epenthesis (post-guttural and phrasal) has indicated they are post-lexical. In the following section, I evaluate these phenomena within OT.

6.5 Opacity Induced by Epenthesis and OT

6.5.1 Parallel OT and Epenthesis

This section shows that Classical OT cannot explain interactions between vowel epenthesis and other processes. Before embarking on the analysis, I need to identify which constraints are needed for epenthesis. For cases where epenthesis is induced by SSP, I utilize the constraint in (14).

- (14). Sonority Sequencing Principle (SSP): The sonority profile of the syllable must form a slope from the syllable peak (nucleus) (Roca, 1994)

This constraint assigns a violation for any onset cluster with a fall in sonority or any coda cluster with a rise in sonority. Since complex onsets are prohibited in SNA, the SSP constraint is restricted to the right edge of the syllable. I need to figure out the ranking of SSP relative to other constraints used in the analyses so far. Given that epenthesis due to SSP is compulsory, SSP must dominate DEP-IO (a constraint against epenthesis): SSP >> DEP-IO (see (15)).

- (15). *Evaluation of ['gabilkum] 'Before You (Plural)'*

/gabl-kum/	Reduce, SSP, WSP	DEP-IO
a. 'ga.((bil)ku)<m>	*! Reduce	*
☹ b. (('ga.bil).kum	*! Reduce *! WSP	*
☞ c. (('gab.li).kum		*
d. ('gab.l).ku<m>	*! SSP	

WSP ensures the heavier syllable within a foot is stressed. In this tableau, however, the desired form (b) does not emerge as optimal because it fatally violates WSP as well as Reduce.

The latter is violated because a surface low vowel in an open syllable does not reduce in duration. Instead, candidate (c) is selected as the optimal form.

Ranking SSP above DEP-IO can motivate a form with the correct epenthesis and eliminate non-epenthetic forms in (d). However, this ranking does not motivate the underlying /a/ to raise nor does it motivate predictable stress location. Assigning Reduce to a lower ranking does not help either.

Further challenges to parallel OT are expected when dealing with phrase-level epenthesis. To account for vowel insertion induced by complex margins, I need to stipulate another constraint. Given that SNA has a sequence of CCCC broken up by epenthesis, I would need to argue that SNA either prohibits semisyllables or complex onsets, but neither possibility is tenable. SNA does allow CC sequences word-initially due to high vowel deletion and trisyllabic elision, as shown in [g.ha.wah] ‘coffee,’ and if SNA does not allow semisyllables at all, a medial CCCC sequence should be split between complex codas and complex onsets (CC.CC). With such a sequence, epenthesis becomes unnecessary. Therefore, I need another motivation for phrasal epenthesis. If semisyllables are only tolerated at the word edge, which is common behavior, I need to assume that Syl- μ dominates DEP-IO to enforce internal epenthesis: Syl- μ >> DEP-IO.

(16). *Evaluation of [’ruħtib.hum] ‘You Took Them with You!’*

/ruħt-b-hum/	COMP _{ONS} FT-BIN/MAX AL-H-R Syl- μ	DEP-IO
a. (’ruħ)tib.)hum<m>	*! FT-BIN/MAX	*
b. (’ruħt.)bhu<m>	*! COMP _{ONS}	
c. (’ruħt.)b.hu<m>	*! Syl- μ	
d. (’ruħ.)((tib.)hu)<m>	*! ALIGN-HEAD-R	*

With the stipulated ranking, the correct output is not selected without a costly violation of FT-BIN/MAX and AL-H-R. A repair for this problem lies in re-ranking either of these constraints below DEP-IO. For the sake of argument, ranking AL-H-R below DEP-IO could get (b) or (d) in position to be selected as optimal, as shown (17).

(17). *Evaluation of [ʼruħ.tib.hum] ‘You Took Them with You!’*

/ruħt-b-hum/	COMP _{ONS} , FT-BIN/MAX, Syl-μ	DEP-IO	AL-H-R
a. (ʼruħ)tib.)hum<m>	*! FT-BIN/MAX	*	
b. (ʼruħt).bhu<m>	*! COMP _{ONS}		
c. (ʼruħt).b.hu<m>	*! Syl-μ		
☹ d. (ʼruħ)((tib.)hu)<m>		*	*!
☹ e. (ʼruħt).bi).hu<m>		*	

The tableau fails to motivate the actual output (d), instead showing (e), and can equally violate DEP-IO with one less violation of AL-H-R. Lowering FT-BIN/MAX instead of AL-H-R would yield a similar outcome. Therefore, this stipulation cannot rule out more troublesome forms with less costly epenthesis, such as (ʼruħt).bi).hu<m> with epenthesis to the right edge of the semisyllable. This potential candidate would not violate FT-BIN/MAX or AL-H-R.

I may need to assume that DEP-IO is in no conflict with these two metric constraints and could therefore justify why they are being exceptionally violated. One argument is that metric constraints are only violable with internal epenthesis, but such a claim was shown to be invalid. As stated in Chapter 4, low vowel insertion takes place between a guttural and a following consonant, e.g., baʃd > [baʃad]. If internal epenthesis is exceptional, there should also be exceptional stress in words like *[ʼ(ba.ʃad).hum], which is not the case.

A last resort solution would be to assume that an output must be mapped to a base candidate in terms of stress. This could be done using a constraint proposed by Pater (2000), stated in (18).

(18). IDENT-STRESS: If a segment x is stressed, then $f(x)$ is stressed (where f is the correspondence relation between input and the output forms. (Pater, 2000, p. 252)

Ranking this constraint above FT-BIN/MAX and ALIGN-HEAD-R could derive the correct word: IDENT-STRESS >> AL-H-R (see the evaluation in (19)).

(19). *Evaluation of [ʔruħ.tib.hum] ‘You Took Them with You!’*

/ruħt-b-hum/ Base: /ʔruħt/	FT-BIN/MAX COMP _{ONS} MAX-C Syl- μ	DEP-IO	IDENT-STRESS	AL-H-R
a. (ʔruħ)((tib.)hu)<m>		*		*
b. (ʔruħt).bhu<m>	*! COMP _{ONS}			
c. (ʔruħt).b.hu<m>	*! Syl- μ			
d. (ruħt)((tib.)hu)<m>		*	*!	
e. (ʔruħt.)hu<m>	*! MAX-C			
f. ((ʔruħ.)tib.)hu<m>	*! FT-BIN/MAX	*		

Assuming that stress must be mapped to base form can explain the unpredictable stress. Thus, (a) is the winner over (d), although it violates AL-H-R because its stress is identical to a hypothetical stem base (ʔruħt).

The problem with this approach is that selecting a base within one paradigm is not always straightforward in Arabic. For instance, the paradigm for (ʔruħt) ‘I went’ also contains [ra:ħ] in [ruħ.na] ‘we went,’ [ʔru:ħu] ‘You (plural) go!’ and [ʔra:ħaw] ‘they went.’ These forms present different types of vowel qualities and vowel duration.¹² Even if there were multiple bases (depending on each inflection), this would not explain the discrepancy between [ʔruħtu] ‘you went’ and [ruħ.tu:.lih] ‘you (plural) went to him’ if they shared one stem base.

¹² Such verbs with a medial root glide are called hollow verbs (see Harrama, 1993).

No Parallel OT accounts can handle epenthesis-induced opacity in SNA. With Classical OT, the evaluation of SSP epenthesis falls short in justifying the exceptional non-raised low vowels in open syllables, as well as stress patterns. For phrasal epenthesis, neither Classical nor Base-Output OT offers a satisfying explanation. In the next section, I evaluate the data within Stratal OT.

6.5.2 Stratal OT and Post-Lexical Epenthesis

This section shows why Stratal OT is superior to other OT accounts in handling the SNA data. By examining the data in SNA, I have argued that SSP epenthesis must be post-lexical. Thus, I first need to show how SSP epenthesis works within this model.

In (20) the evaluation shows how ['ga.bil.kum] can be analyzed through Stratal OT. If SSP enforces epenthesis post-lexically only, it is not operative at the stem level. Thus, for the stem level, I rank SSP below DEP-IO: DEP-IO >> SSP.

At the stem level, an underlying CVCC stem is evaluated regardless of the sonority scale in the coda clusters. Thus, candidate (a) is the winner over (b) since SSP-induced epenthesis violates a higher constraint, IDENT-IO (V). Candidate (c) violates Reduce due to the non-raised low vowel, whereas (d) triggers a violation of $\sigma\mu\mu$, which requires heavy syllables to coexist with a foot and therefore bear stress. Table 100 moves to the word level, the level at which object suffixes are attached.

(20). *Stem-Level Evaluation of ['gabilkum] 'Before You (Plural)'*

/gabɪ/	Reduce FT-BIN/MAX WSP, $\sigma\mu\mu$, AL-H-R	DEP-IO	IDENT- IO (V)	SSP
☞ a. ('gabɪ)				*
b. ('gɪbɪ)			*	*
c. ('gabɪl)	*! Reduce	*!		
d. gabɪ	*! $\sigma\mu\mu$			

(21). *Word-Level Evaluation of ['ga.bil.kum] 'Before You (Plural)'*

/'gabl-kum/	FT-BIN/MAX, WSP, σμμ, AL-H-R	DEP- IO	Reduce	IDENT-IO (V), SSP
☞ a. ('gabl.)ku<m>				*
b. gabl.ku<m>	*! σμμ		*	*
c. ('ga.bil.)ku<m>	*! WSP	*	*	
d. (('gabil).ku)<m>	*! FT-BIN/MAX *! WSP	*		
e. ('gab).(li.ku)<m>	*! AL-H-R	*		
f. (('gab).li).ku<m>		*!		

When a CVC suffix attaches to the stem, the output shape is now ('S)L with the extrametricality of the final consonant. This means stress remains on the initial syllable. As a result, candidate (a) is selected as the winner at the word level, even though it has a complex coda cluster.

Post-lexically, I must show an interaction where SSP is dominant over DEP-IO. Therefore, I propose that SSP is re-ranked at the post-lexical level: SSP >> DEP-IO. To justify the underapplication of VR (Reduce), I must re-rank IDENT-IO (V) over Reduce as well: IDENT-IO (V) >> Reduce. This reranking mitigates against post-lexical changes in vowel quality that would have occurred at stem and word levels, as depicted in (22).

(22). *Post-Lexical Evaluation of ['ga.bil.kum] 'Before You (Plural)'*

/'gabl-kum/	SSP, FT-BIN/MAX, WSP, σμμ, AL-H-R	DEP- IO	IDENT -IO (V)	Reduce
a. ('gabl.)ku<m>	* SSP			*
b. ga. (('bil).ku)<m>		*		*!
☹ c. ("ga.bil).ku<m>	*! WSP	*		*
d. (('ga.bil).ku)<m>	*! FT-BIN/MAX *! WSP			
e. ('gab).(li.ku)<m>	*! AL-H-R	*!		*
☞ f. (('gab).li).ku<m>		*!		

However, the tableau fails to derive the desired form, which would be either (c) or (d). Candidate (c) should be the target since it incurs only one violation. To overcome this, I propose that a stressed syllable in the output must have a corresponding stressed syllable in the input. In

other words, at the post-lexical level, IDENT-STRESS must be re-ranked at the top to eliminate any stress dislocation post-lexically: IDENT-STRESS >> WSP.

Additionally, I have not ruled out a possible candidate like (f) where a vowel is inserted after the consonants in the stem cluster rather than between them. I need to justify the location of epenthesis. A constraint that favors stem-internal epenthesis was proposed earlier, AL-R-R, which I used with feminine suffix vowel deletion. This constraint aligns to the right edge of a root with a right syllable boundary. A quick repair would be to demote WSP below AL-R-R in the hierarchy: AL-R-R >> WSP (see (23)).

(23). *Post-Lexical Evaluation of ['ga.bil.kum] 'Before You (Plural)'*

/'gabl-kum/	SSP,IDENT-STRESS, FT-BIN/MAX, σμμ, AL-H-R	DEP-IO	AL- R-R	WSP	IDENT -IO (V)	Reduce
a. ('gabl.)ku<m>	*! SSP					*
b. ga.('bil).ku<m>	*! IDENT-STRESS					*
☞ c. ('ga.bil).ku<m>		*		*		*
d. (('gabil).ku)<m>	*! FT-BIN/MAX *! WSP					
e. ('gab).(li.ku)<m>	*! AL-H-R	*	*			*
f. (('gab).li).ku<m>		*	*!			
g. ('gi.bil).ku<m>		*		*	*!	

Now I can justify why (c) is selected as the winner. Leaving the first CVCC syllable with a rise in sonority over its edge incurs a violation of SSP. Therefore, an insertion must occur. With epenthesis, the metrical constraint WSP is now violable due to its relative ranking compared to IDENT-STRESS. Candidate (c) fares better than (f) for not violating the morphological alignment constraint AL-R-R. It also fares better than (g), which violates the now higher constraint IDENT-IO (V).

Up to this point, I have examined the post-lexical level to account for opacity and SSP-induced epenthesis in SNA. Next, I test the analysis with phrasal epenthesis. Given that I am

dealing with a sequence of four consonants CCCC, and having established that SNA prohibits complex onsets, a semisyllable is at least licensed at the lexical level. The semisyllable is a headless syllable with no mora assigned. Otherwise, a consonant would be left unaffiliated with a syllable node, which is prohibited by LICENSE-C and must be ranked above Syl- μ : LICENSE-C >> Syl- μ .

(24). *Stem-Level Evaluation of ['ruħ.tib.hum] 'You Took Them with You!'*

/ruħt/	LICENSE-C, COM _{ONS} , FT-BIN/MAX, WSP, σμμ, AL-H-R	DEP-IO	Syl- μ
☞ a. ('ruħt)			
b. ruħt	*! σμμ		

At the stem level, only metrical constraints are applied, and stress is assigned on the monosyllabic word.

(25). *Word-Level Evaluation of ['ruħ.tib.hum] 'You Took Them with You!'*

/'ruħt-b-hum/	LICENSE-C, COM _{ONS} , FT-BIN/MAX, WSP, σμμ, AL-H-R, WBP	DEP-IO	Syl- μ
a. ('ruħt)b.hu<m>	*! WBP		*
b. ('ruħt).bhu<m>	*! COM _{ONS}		
☞ c. ('ruħt).b.hu<m>			*
d. ('ruħt).b.hu<m>	*! LICENSE-C		
e.(ruħ.)(('tib).hu)<m>		*!	
f. ('ruħ.)((tib.)hu)<m>	*! AL-H-R	*	
g. (('ruħ.)(tib.)(hu)<m>	*! FT-BIN/MAX	*	

When the dative and the object suffixes attach, a semisyllable is the least costly option. Parsing a syllable with a complex onset, as in (b), is banned by COM_{ONS}. Similarly, leaving a consonant without a syllable, as in (d), incurs a violation of LICENSE-C. Vowel insertion to avoid the semisyllable, as in (e), is fatal because this repair violates DEP-IO. As a result, candidate (a) is the winner in this tableau, which triggers a more violable constraint Syl- μ . Note

the representations of (a) and (d) in (24) are identical. However, candidate (a) represents a syllable without a mora (a semisyllable), whereas candidate (d) represents a consonant that is parsed to the prosodic word with no syllable node.

At the post-lexical level, the constraint Syl- μ is promoted over the anti-epenthesis constraint DEP-IO: Syl- μ >> DEP-IO.

(26). *Post-Lexical Evaluation of ['ruħ.tib.hum] 'You Took Them with You!'*

/ruħt-b-hum/	IDENT-STRESS. LICENSEC, COM _{ONS} , FT-BIN/MAX, σμμ, AL-H-R	Syl- μ	DEP-IO
a. ('ruħt)b.hu<m>		!*	
b. ('ruħt).bhu<m>	*! COM _{ONS}		
c. ('ruħt).b.hu<m>	*! LICENSE-C		
d. (ruħ.)(('tib).hu)<m>	IDENT-STRESS		*
e. ('ruħ.)((tib).hu)<m>	*! AL-H-R		*
f. (('ruħ).tib)hu)<m>	*! FT-BIN/MAX		*

Promoting Syl- μ over DEP-IO enforces epenthesis to avoid a semisyllable. The evaluation nonetheless fails to select the actual output, which is either (e) or (f). To overcome this problem, I need to demote AL-H-R or FT-BIN/MAX below Syl- μ . While either option could produce the desired output, demoting FT-BIN/MAX to a lower ranking is problematic. In addition to giving up the maximal weight I proposed for foot size, other constraints would be compromised, such as TROCHEE. In that case, I would need a new set of constraints to account for feet of the ('HHL) shape.

As an alternative, I assume AL-H-R undergoes demotion post-lexically: Syl- μ >>AL-H-R (see (27)). With this ranking, the actual form (a) is the winner, even though it violates End Right Rule represented by AL-H-R.

(27). *Post-Lexical Evaluation of ['ruħ.tib.hum] 'You Took Them with You!'*

/ruħt-b-hum/	IDENT-STRESS, LICENSE-C, COM _{ONS} , FT-BIN/MAX, σμμ	Syl-μ	AL-H-R	DEP-IO
a. ('ruħt)b.hu<m>		!*		
b. ('ruħt).bhu<m>	*! COM _{ONS}			
c. ('ruħt).b.hu<m>	*! LICENSE-C			
d. (ruħ.)(('tib).hu)<m>	*! IDENT-STRESS			*
e. (ruħ.)(('tib.)hu)<m>			*	*
f. (('ruħ).tib)hu)<m>	*! FT-BIN/MAX			*

As noted previously, a sequence of consonants can exist word-initially in SNA due to trisyllabic elision or high vowel deletion: [k.tibat] ‘she wrote,’ [s.ħa.bih] ‘he pulled him.’ I argued that such a sequence does not belong to one syllable but rather consists of a semisyllable consonant followed by a syllable. If this is the case, then why are such semisyllables retained post-lexically? Thus, I need to explain why initial semisyllables do not behave like internal semisyllables in SNA and enforce epenthesis. I propose that SNA allows semisyllables to surface post-lexically only at the word periphery, i.e., initially. According to Kiparsky (2003), semisyllables are “sometimes restricted to peripheral positions,” “typically the word edges” (p. 156), and SNA exemplifies this. I argue this generalization about semisyllables should be restricted to the word periphery in SNA. To generate such a restriction, I hypothesize one additional constraint that bans word-internal semisyllables, modifying a general constraint I already have (Syl-μ), as in (28).

(28). Syl-μ word-internally (Syl-μ (Wrd-Int.)): Every internal syllables must contain a mora.

The lexical–post-lexical interaction of Syl-μ (Wrd-Int.) with the other two constraints (Syl-μ Wrd-Int. and LICENSE-C) shapes the output at each level. LICENSE-C is always inviolable, whereas Syl-μ word-internally is violable at the stem and word levels. At the post-lexical level, however, Syl-μ (Wrd-Int.) is reranked to a higher position. Compare this with Syl-μ, which can be violable at all levels. The evaluation in (29) shows how this works.

(29). *Post-Lexical Evaluation of [k.'ta:b.hum] 'Their Book!'*

/k μ .'ta:b.hum/	Syl- μ (Wrd-Int.) IDENT-STRESS LICENSE-C COM _{ONS} FT-BIN/MAX, $\sigma\mu\mu$	AL-H-R	DEP-IO	Syl- μ
☞ a. k.(.'ta:b.)hu<m>				*
b. ('kta:b.)hu<m>	*! COM _{ONS}			
c. k.(.'ta:b.)hu<m>	*! LICENSE-C			
d. ki.(.'ta:b.)hu<m>			*!	

For peripheral semisyllables, vowel epenthesis is not enforced, because μ remains low-ranked. As a result, no change occurs at the post-lexical level in words with initial C.C sequences. This can be compared to (30)

(30). *Post-Lexical Evaluation of ['ruħ.tib.hum] 'You Took Them with You!'*

/'ruħt-b-hum/	Syl- μ (Wrd-Int.) IDENT-STRESS LICENSE-C COM _{ONS} FT-BIN/MAX, $\sigma\mu\mu$	AL-H-R	DEP-IO	Syl- μ
a. ('ruħt)b.hu<m>	*! Syl- μ (Wrd-Int.)			*
b. ('ruħt).bhu<m>	*! COM _{ONS}			
c. ('ruħt).b.hu<m>	*! LICENSE-C			
d. (ruħ.)(('tib).hu)<m>	IDENT-STRESS		*	
☞ e. ('ruħ.)(('tib).hu)<m>		*	*	
f. (('ruħ).tib)hu<m>	*! FT-BIN/MAX			

Now the same output (e) is achieved, even after adding the new constraint Syl- μ (Wrd-Int.). This stipulation makes a distinction between internal semisyllables, which are prohibited post-lexically, and peripheral semisyllables, which are tolerated throughout the three levels.

Stratal OT offers a better explanation for the different types of opacity encountered in this chapter. Without different strata or levels of phonology, the interaction of some processes cannot be fully explained.

6.6 Conclusion

This chapter examined phonological processes that seem to induce opacity in SNA. The first type of opacity is associated with epenthesis in CVCC stems motivated by sonority requirements. The interaction of this epenthesis with stress and vowel raising/deletion leads to a type of double opacity. Similar phenomena were found in other processes induced by internal complex margins. After evaluating multiple views on opacity, I demonstrated that lexical phonology provides the better analysis. The idea is that epenthetic vowels that are ignored by stress must be inserted post-lexically after all other processes have been applied. I compared SSP epenthesis with post-guttural epenthesis, in which the epenthetic vowel always receives stress. Furthermore, I analyzed the data within Stratal OT, a model that combines constraint ranking with serial ordering, such that phonological processes can apply at different strata.

The key to solving the opacity problem was re-ranking two constraints at the post-lexical level, SSP and IDENT-STRESS. IDENT-STRESS requires stressed syllables in the input to remain stressed in the output, such that a stressed syllable at the lexical level remains stressed post-lexically. For complex margins, I proposed a constraint against word-internal semisyllables, Syl- μ (Wrd-Int.). This constraint can be distinguished from Syl- μ , which allows initial semisyllables to appear in SNA.

Chapter 7: Conclusion

This study has analyzed syllable structures and related phonological phenomena in SNA, an underreported Arabic dialect. In doing so, it has shed light on some of the main challenges in the literature associated with vowel processes and syllabification patterns in Bedouin dialects. SNA was shown to have unique phonological features such as a wider distribution of superheavy syllables and unusual stress patterns. While most vowel processes in SNA are common in Arabic dialects and have been well studied, this analysis attempted to bridge a gap between traditional and constraint-based approaches. In probing the data, I have used several frameworks, including Moraic Theory, Metrical Stress Theory (Hayes, 1989, 1995; McCarthy & Prince, 1986), lexical phonology, OT (McCarthy & Prince, 1993; Prince & Smolensky, 1993, 2004), and Stratal OT (Kager, 1999b, Kiparsky 2000, 2003, 2015).

Chapter 2 explored syllabification patterns and syllable structures in SNA with an emphasis on superheavy syllables. Although the dialect appears to allow complex margins in onsets and codas, I argued that only consonant clusters in codas are permissible, because sonority requirements are only enforced in codas. For superheavy CVVC and CVCC syllables, I evaluated four approaches and argued that SNA appears to allow trimoraic syllables in derived contexts due to syncope or suffixation. Within OT, I showed that each consonant must add to the weight of the syllable based on the WBP rule, and a binary syllable constraint SYL-BIN must be violable to accommodate the extra consonant.

Chapter 3 examined four phonological processes: vowel raising, high vowel deletion, trisyllabic elision, and feminine suffix vowel deletion. While all of them have been reported in other Arabic dialects, linear and non-linear approaches have had shortcomings in analyzing vowel processes in Bedouin dialects generally and Najdi dialects in particular. Following

Kirchner (1996) and McCarthy (1999, 2003), I proposed that Reduce could be the motivation for most of the vowel raising and high vowel deletion in SNA. This constraint dictates a reduction in vowel duration on a scale of [a] > [i], [u] > Ø, where Ø stands for deletion. For trisyllabic elision, I suggested a constraint in SNA that disallows sequences of light syllables, *LL. Since trisyllabic elision involves syncope in one of two light syllables, I addressed directionality and proposed the well-formedness constraint *COD where closed syllables are marked. For feminine suffix vowel deletion, a morphological alignment constraint was proposed that requires the left edge of a root to be aligned with a syllable boundary.

Chapter 3 went on to address opacity in SNA, when multiple processes interact and non-surface-true forms arise. While such interaction can traditionally be explained by rule ordering, this falls short in explaining all phenomena of opacity, particularly when trisyllabic elision and feminine suffix vowel deletion are involved. Parallel OT likewise failed to justify these opaque patterns. Therefore, I utilized a lexical phonology model known as Stratal OT, in which multiple phonological phenomena can apply in different levels induced by morphological domains. Following Kiparsky (2000, 2003), I proposed that SNA has three levels: two lexical levels (stem and word) and a post-lexical level. In Stratal OT, each level represents one stratum of evaluation, allowing opacity since outputs are susceptible to multiple mappings.

Chapter 4 addressed an additional phonological process in SNA, guttural metathesis. I provided a reanalysis of CV or guttural metathesis in light of the SNA data, showing that it is actually derived from epenthesis plus deletion, given that each process has a different motivation. This phenomenon was identified as pseudometathesis and was supported by evidence from SNA and other Arabic dialects. The first motivation was evident in the behavior of preconsonantal gutturals following a low vowel. This string of segments appears to trigger

post-guttural epenthesis. The other motivation lies in an established process, trisyllabic elision, where sequences of light syllables are reduced to one light syllable (CVCV > C.CV).

Within OT, I hypothesized that post-guttural epenthesis is motivated by micro-constraints that form a marked sequence */GC/. The first micro-constraint militates against preconsonantal gutturals, while the second disallows sequences of pharyngeal segments, i.e., gutturals and low vowels. The latter is crucial to understanding why other vowels do not trigger epenthesis. Within this analysis, I entertained a competitive approach where metathesis was the solution for satisfying this constraint, but this approach faced several limitations. A key point in my argument is that SNA exhibits forms with post-guttural epenthesis yet no metathesis on the surface, strongly motivating epenthesis as an independent process.

Next, I probed the morphological domain in which post-guttural epenthesis and syncope operate. The data showed that */GC/ must be available in the first lexical level (the stem). Residual cases were shown to exist as exceptions to pseudometathesis, but this was limited to forms with quadri-consonantal roots in a cross-morphemic environment where a guttural and the following consonant belong to separate morphemes.

Chapter 5 provided a suprasegmental analysis of SNA within Metrical Stress Theory. First, I argued that extrametricality is a factor in stress placement for all word-final consonants regardless of syllable shape. Second, I showed that SNA has a trochaic stress system with left-to-right parsing. Although most stress patterns were similar to most Arabic dialects, some distinctive stress patterns were found. One such pattern pertains to the behavior of final CVG syllables. In addition, SNA appears to distinguish antepenultimate CVC and CVXC syllables when followed by two light syllables. While the former always attracts stress, the latter does not, even though it is arguably heavier. Such behavior was accounted for by adopting trimoraic foot

parsing, where heavy syllables are part of a larger foot, and superheavy syllables exhaust a foot given that they are trimoraic.

Within OT, I suggested that a trimoraic foot is possible in SNA by modifying the BIN constraint to accommodate maximally trimoraic feet. This was shown to be an economic move to reduce the number of feet in a word through a TRI constraint that disfavors minimal/binary feet.

Chapter 6 further addressed opacity issues in SNA that arise with a few vowel epenthesis phenomena induced by SSP requirements in coda clusters. Whenever a cluster ends in a rise in sonority, epenthesis occurs and leads to opacity in terms of vowel raising. Additionally, when these forms are suffixed and still require SSP epenthesis, double opacity arises for vowel raising and stress location. Similar patterns were found in phrase-level epenthesis motivated by CCCC clusters. I proposed that this epenthesis must occur at the post-lexical level, where vowel raising and stress are no longer available.

Within Stratal OT, I suggested that SSP must be ranked low in the lexical phonology. However, at the post-lexical level, SSP is undominated. To justify the underapplication of vowel raising and stress, I proposed faithfulness constraints that keep the stress and vowel quality unchanged. These constraints are ranked higher than Reduce and some metrical constraints. For phrasal epenthesis, I proposed that word-internal semisyllables are only permissible at the lexical level, CC.C.C. At the post-lexical level, a word-internal semisyllable is banned, so a vowel must be inserted.

Although this study was mainly based on SNA, some of the arguments could be extended to similar features in other Bedouin dialects. For instance, trisyllabic elision and its interaction with feminine suffix vowel deletion (or low vowel deletion) could be better analyzed within lexical phonology. Both processes have been reported in several Bedouin dialects, and future

work could replicate the present study in other dialects. Another example is the adoption of a trimoraic stress pattern. Most stress patterns have been based on a binary system, but a ternary system might account for otherwise inexplicable stress assignment.

While this study has demonstrated various unique features in SNA, several aspects remain unexplored. One is the underapplication of vowel raising before alveolar sonorants. Another, reported in Chapter 4, is the blocking of post-guttural epenthesis in some environments. I have speculated that morphological domains might be a factor in the process, but these issues merit future documentation and analysis.

This dissertation has offered an in-depth, constraint-based analysis of syllable-based phonological phenomena in Southern Najdi Arabic. In doing so, it has shed light on an understudied Bedouin dialect of Arabic, and also offered new theoretical frameworks that could potentially be applied to future re-analyses of Arabic phonology in general.

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