Non-metrical vowel optimization and iambic unevenness in Arabic

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Abstract

In this paper, I propose a constraint-based analysis for three processes affecting short vowels. In the Zilfaawi, Negev, and Jordanian dialects, syncope targets [i, u] in non-final open syllables, while raising targets [a] in the same environment in Negev and Zilfaawi. I analyze deletion of [i, u] and raising of [a] as a pressure to reduce the duration of short vowels in open syllables (Kirchner, 1996). Zilfaawi also has deletion of [a], which only happens in the dependent syllable of an iamb, which I analyze as promoting the unevenness of the iamb (McCarthy, 2003). Gouskova (2003) claims that vowel processes must be due to either metrical or sonority constraints on nuclei and foot branches. Moreover, she argues that while the marked segment can be banned, the least marked segment cannot be. I will show that high vowel deletion and low vowel raising in these dialects cannot be attributed to these constraints but rather must be attributed to a REDUCE constraint that minimizes vowels duration in open syllables. In Zilfaawi, low vowel deletion applies before a light syllable: in an open syllable followed by another non-final open syllable, and in an open syllable followed by a final CVC (where the word-final C is weightless). However, deletion is blocked before a heavy syllable. This deletion process is metrical, because low vowels delete to improve the duration contrast inside iambs, making the dependent syllable as short as possible, leaving the preceding consonant as a semi-syllable.

Keywords: phonology; Zilfaawi Arabic; metrical; iamb; duration

1. Introduction

In this paper, I will account for three processes affecting short vowels– high vowel syncope, low vowel raising, and low vowel deletion—in three dialects of Arabic: Zilfaawi, Negev, and Jordanian. Syncope is a general process that targets high vowels /i, u/ in non-final open syllables in all three dialects, while raising targets the low vowel /a/ in the same environment in Negev and Zilfaawi, but not in Jordanian Arabic. Moreover, a low vowel deletes in Zilfaawi Arabic when it appears in a non-final open syllable and is followed by another non-final open syllable or followed by a final CVC syllable. While several studies have discussed vowel syncope in various dialects of Arabic (Gouskova, 2003; Kager, 1999; Kiparsky, 2003; McCarthy, 2003; Watson, 2007 among others), this is the first paper to compare these three dialects and to present a unified account of vowel deletion and vowel

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raising. I will argue that the short vowel alternations in these three dialects of Arabic are driven by two requirements. First is the requirement to reduce the duration of short vowels in open syllables by deleting high vowels and raising low ones to satisfy the constraint REDUCE, which works to minimize the duration of short vowels in non-final open syllables (Kiparsky, 2003; Kirchner, 1996; McCarthy, 2003). Second is the requirement to create uneven iambic feet by deleting the low vowel in non-final open syllables to satisfy the constraint GROUPINGHARMONY, which militates against having even iambic feet (McCarthy, 2003).

Gouskova (2003) argues that vowel syncope can be a result of one of two factors. One is the effect of metrical constraints, where the constraints that are responsible for stress placement, e.g. PARSE-s, SWP, etc., are also responsible for syncope, as in Hopi, Tonkawa, and Southeastern Tepehuan. In these languages, syncope takes place to reduce the number of unfooted syllables or to place stress on heavy syllables. Second is the effect of general constraints against marked nuclei, *NUC/i,u, marked low-sonority vowels in foot peaks, *PKFT/i,u, or marked high-sonority vowels in foot margins, *MARFT/a.

On the one hand, by looking at the vowel processes in all three dialects, low vowel deletion is captured by Gouskova's metrical factor because low vowels delete to improve the metrical structure. However, the metrical motivation for deletion is different from the ones proposed by Gouskova (2003) for the languages in her paper. Low vowel deletion in Zilfaawi takes place to create uneven iambic feet. On the other hand, high vowel syncope cannot be metrical because it targets vowels in positions in which deletion neither creates a better prosodic form, nor reduces the number of unfooted syllables. One example is the input /kitaab/ in the iambic dialects Negev Arabic and Zilfaawi Arabic, where the underlying (LH) /kitaab/ maps to [ktaáb] or [k.taáb] 'a book', depending on foot preference in the language. If this deletion is metrical, we do not expect high vowel deletion to take place because (LH) is already a perfect foot. Moreover, high vowel syncope and low vowel raising cannot be captured by any of Gouskova's constraints against marked vowels in specific positions for several reasons. First, in Zilfaawi and Negev Arabic, all three short vowels, /i, u, a/, undergo vowel deletion or raising. The high vowels {i, u} syncopate and the low vowel /a/ raises in non-final open syllables. Therefore, it is not obvious what the least marked vowel in these dialects is. Second, low vowel raising takes place regardless of the vowel's position in the word. In words like /katab-at/ [(k.tí.)bat] 'she wrote', /zama:n/ [(zi.maːn)] 'era', and /miʃtaʁil/ [(míʃ).tiʁil] 'working, past participle, MASC', the low vowel raises in the foot peak, the foot margin, and in an unfooted syllable, respectively. Third, high vowel syncope is not also limited specific positions. In addition to deleting high vowels in foot margins and unfooted syllables, a high vowel deletes in words like /ʃarib-it/ [(ʃár)bit] 'she drank', although it is in the designated position of stress in Negev Arabic.

This paper is organized as follows: In section 1.1, I give a brief overview of the three dialects of Arabic under study. In section 2, I provide vowel syncope and raising cases and their blocking conditions, which illustrate the short vowel alternations in these dialects. In section 3, a brief introduction to how the transparent stress systems work in all three languages is presented to elucidate why the low vowel deletes in Zilfaawi but not in the other two dialects. In sections 4 and 5, I pursue an analysis of the stress patterns, the vowel alternations, and their blocking conditions in all three dialects within the OT framework.

1.1 The Arabic dialects under study

This paper focuses on three dialects of Arabic: Zilfaawi, Negev, and Jordanian. Zilfaawi Arabic is a sub-dialect of Najdi Arabic spoken in the central part of Saudi Arabia, and the native language of the author. Negev Arabic is a variety of Arabic spoken in the Negev in Israel. The data in this paper are based on the dialect spoken by the Zullam tribe as reported by Blanc (1970). The third dialect is

Jordanian Arabic, specifically the variety spoken in the Ajlon mountain area. The data are taken from two sources, Alghazo (1987) and Al-Sughayer (1990). These dialects were chosen because they have some interesting similarities and differences, which make them ideal for a comparative analysis.

2. Vowel syncope and vowel raising

In this section I discuss the processes, which affect short vowels in non-final open syllables. In Zilfaawi, Negev, and Jordanian Arabic, as in many other dialects, the high vowel /i/ syncopates when it appears in a non-final open syllable. (Syncope also applies to the high vowel /u/, but because this vowel is far less frequent, the focus will be on /i/.) In the following examples, stems ending in the sequence /-iC/ lose the high vowel when vowel-initial suffixes are added.

(1) Zilfaawi Arabic

a.　[ják.tib]　　　　　'he writes'
　　[jak.tbúːn]　　　'they write, MASC'
b.　[ħáː.kim]　　　　'a ruler, MASC'
　　[ħáːk.mih]　　　'a ruler, FEM'

(2) Negev Arabic

a.　[náː.gil]　　　　'transporting, active participle, MASC'
　　[naːg.líːn]　　　'transporting, active participle, PL'
b.　[ti.líd]　　　　　'to give birth, FEM'
　　[tíl.din]　　　　'to give birth, FEM, PL'

(3) Jordanian Arabic

a.　[ʔa.ráː.sil]　　　'I correspond'
　　[ʔa.ráːs.luh]　　'I correspond with him'
b.　[káː.tib]　　　　'a writer, MASC'
　　[káːt.beh]　　　'a writer, FEM'

In addition to high vowel deletion, in Zilfaawi and Negev Arabic, the low vowel /a/ is raised to /i/ when it occurs in a non-final open syllable, the same environment in which high vowels are deleted:

(4) Zilfaawi Arabic

a.　[ktáb]　　　　　'he wrote'
　　[ktíbow]　　　　'they wrote'
　　[ktíbat]　　　　'she wrote'

(5) Negev Arabic

a.　[ʃarbaw]　　　　'they drank'
　　[ʃirib]　　　　　'he drank'
b.　[jin.kát.luw]　　'he will be killed'
　　[jín.ki.til]　　　'they will be killed'

In contrast, in Jordanian Arabic the low vowel does not raise in a non-final open syllable:

(6) Jordanian Arabic

a.   [ká.ta.bu]   'they wrote'
b.   [ħa.bas]   'he imprisoned'
c.   [gá.la.mak]   'your pen'

   Although Zilfaawi and Negev Arabic show low vowel raising, this low vowel raising is blocked when the low vowel is preceded by one of the guttural sounds /χ, ʁ, ħ, ʕ, h, ʔ/.

(7) Zilfaawi Arabic

a.   [lʕáb]   'he played'
b.   [lʕábat]   *[lʕíbat]   'she played'

(8) Negev Arabic

a.   [ʁa.nám]   *[ʁi.nám]   'sheep'
b.   [ʁadá]   *[ʁidá]   'lunch'
c.   [a.kál]   *[ʔi.kál]   'he ate'

   Finally, in Zilfaawi Arabic but not in Negev or Jordanian Arabic, a low vowel deletes when it occurs in a non-final open syllable, only when this syllable is followed by another non-final open syllable, as in (9a,b) or a final CVC syllable, as in (9c,d).

(9) Zilfaawi Arabic

a.   [la.ʕáb.na]   'we played'
     [lʕá.bat]   'she played'
b.   [ʁa.nám.ha]   'her sheep'
     [ʁní.mi]   'my sheep'
c.   [la.ʕáb.na]   'we played'
     [lʕáb]   'he played'
d.   [saħábt]   'I pulled
     [sħáb]   'he pulled'

   In contrast, the low vowel does not delete in this context in Negev or Jordanian Arabic.

(10) Negev Arabic

a.   [ga.há.wah]   *[ghá.wah]   'coffee'
b.   [zalámah]   *[zlá.mah]   'he killed him'
c.   [daxál]   *[dxál]   'he wrote

(11) Jordanian Arabic

a.   [ká.ta.bu]   'they wrote'
     [kátab]   'he wrote'
b.   [dá.ra.su]   'they studied'
     [dáras]   'he studied'

   In summary, all three Arabic dialects share one phonological process, namely deletion of a high vowel when it appears in a non-final open syllable. However, the dialects differ in the behavior of low vowels in open syllables. In Negev and Zilfaawi Arabic, a low vowel raises when it appears in a non-final open syllable (and is not preceded by a guttural consonant). Additionally, in Zilfaawi Arabic a

low vowel deletes when it appears in a non-final open syllable and is followed by another non-final open syllable or by a final CVC syllable. The following is a summary of all phonological processes discussed in this section:

(12)

	Short vowel processes	Jordanian	Negev	Zilfaawi
a.	High vowel syncope	✓	✓	✓
b.	Low vowel raising	✗	✓	✓
c.	Blocking of low vowel raising: adjacency to gutturals	✗	✓	✓
e.	Low vowel deletion	✗	✗	✓

Comparison of the stress systems of the three dialects will allow us to see why the low vowel deletes in Zilfaawi but not in the other two dialects. Below I argue that in Zilfaawi Arabic, low vowel deletion takes place to enhance the durational contrast between the syllables of the iambic foot. In the next section I provide a brief introduction to the stress systems of the three dialects.

3. Stress

The stress systems of these three dialects have many similarities. They all place stress on the final superheavy syllable. If the final syllable is not superheavy, the next landing site of stress is the rightmost heavy syllable. The dialects also agree on restricting stress on the last three syllables of the PrWd from the right edge. However, they differ in terms of their preferred foot structure.

3.1 Negev Arabic

Stress in Negev Arabic falls on one of the last three syllables of the prosodic word. The syllable weight and syllable position determine the landing site of stress based on the following rules proposed by Hayes (1995:226):

A.   Stress a final superheavy syllable:

(13)

a.   [miʃ.taʁ.láː.t]   'working, participle'
b.   [ki.tábt]   'I wrote'

B.   Otherwise, stress a heavy penultimate:

(14)

a.   [ʁa.nám.na]   'sheep (individuals)'
b.   [baʃ.ʃíb.ríj.jah]   'by the knife'

C.   Otherwise, stress a heavy antepenultimate:

(15)

a.   [ál.ʁa.nam]   'the sheep'
b.   [as.táf.ha.mah]   'he queried him'

D.   In disyllabic words starting with a light syllable, stress the final syllable:

(16)

a.   [ǰimál]   ' a camel'
b.   [ʔakál]   'he ate'

E.   Otherwise, stress the antepenultimate or penultimate syllable, whichever is separated by an odd number of light syllables from the closest preceding heavy syllable, or from the beginning of the word if there is no such syllable:

i. Penult:

(17)

a.   [ga.há.wa]   ' coffee'
b.   [an.kisárat]   'it broke'

ii. Antepenult:

(18)

a.   [za.lá.ma.tak]   'your man'
b.   [ra.gá.ba.tih]   'his neck'

3.2 Jordanian Arabic

   Jordanian Arabic also has a three-syllable stress window. The syllable weight and syllable position determine the landing site of stress, according to the stress rules mentioned by Alghazo (1987):

A.   Stress a final superheavy syllable:

(19)

a.   [damaːr]   'destruction'
b.   [χaːj.faːt]   'they are scared, FEM'

B.   Otherwise, stress a heavy penultimate:

(20)

a.   [jiʃ.táʁ.lu]   'they work, MASC'
b.   [χaːl.hum]   'their uncle'

C.   Otherwise, stress a heavy antepenultimate:

(21)

a.   [jínkatil]   'he is to be killed'
b.   [múħ.ta.ram]   'respectable, MASC'

D.   In disyllabic words starting with a light syllable, stress the initial syllable:

(22)

a.   [kátab]   'he wrote'
b.   [dáwa]   'medicine'

E.   Otherwise, stress the antepenultimate syllable:

(23)

a.   [ká.ta.bu]   'they wrote, MASC'
b.   [miz.rá.ʕa.tu]   'his farm'

3.3 Zilfaawi Arabic

Stress is also determined by syllable weight and syllable position in Zilfaawi Arabic. The stress rules of this dialect are as follows:

A.   Stress a final superheavy syllable:

(24)

a.   [ħa.bíːb]   'he is lovable'
b.   [mak.tu:báːt]   'they are written, FEM'

B.   Otherwise, stress a heavy penultimate:

(25)

a. [ká:tib] 'a writer, MSAC'

b. [mákkah] 'Mecca'

C.   Otherwise, stress a heavy antepenultimate:

(26)

a. [sá:faro] 'they travelled, MASC'

b. [χá:litih] 'his aunt'

D.   In disyllabic nouns starting with a light syllable, stress the initial syllable:

(27)

a. [ʕá.mal] 'a job'

b. [ʁá.nam] 'sheep'

E.   In disyllabic verbs starting with a light syllable, stress the final syllable:

(28)

a. [ʔa.kál] 'he ate'

b. [ʔa.χáð] 'he took'

F.   Otherwise, stress the penultimate syllable:

(29)

a. [ʔa.ká.lat] 'she ate'

b. [ʔu.má.ra] 'princes'

I will assume, as in several Arabic dialects that a final consonant is extrametrical, which means that it does not contribute to weight. Therefore, final CVCC and CVVC will have the same weight as nonfinal CVC and CVV, respectively. Moreover, the final CVC will be as light as CV word-finally.

These stress patterns are summarized in the following table:

(30)

		Jordanian	Negev	Zilfaawi
a.	Stress the final superheavy syllable	✓	✓	✓
b.	Otherwise, stress a heavy penultimate	✓	✓	✓
c.	Otherwise, stress a heavy antepenultimate	✓	✓	✓
d.	Otherwise, stress the antepenultimate syllable	✓	✗	✗
e.	Otherwise, stress the antepenultimate or penultimate syllable, whichever is separated by an odd number of light syllables from the closest preceding heavy syllable, or from the beginning of the word if there is no such syllable	✗	✓	✗
f.	In disyllabic words starting with light syllables, stress the initial syllable	✓	✗	✗
g.	In disyllabic words starting with light syllables, stress the final syllable	✗	✓	✗
h.	In disyllabic words starting with light syllables, stress the final syllable if it is a noun and the final syllable if it is a verb	✗	✗	✓

The datasets in the above sections have been used to illustrate short vowel alternations and to describe the stress systems of the three dialects. Below, I will account for what we have seen in the grammar of these dialects within the OT framework.

4. Analysis

4.1 Stress

The three dialects exhibit two different foot types: iambic and trochaic. Based on the data and analysis of Alghazo (1987), it can be said that Jordanian Arabic is a trochaic variety of Arabic; therefore, feet are left-headed in the PrWd respecting the RH-TYPE=T constraint that determines the foot type, as shown below.

(31) RH-TYPE=T   (Kager, 1999)
Feet have initial prominence.

However, based on the data presented in section 3, I argue that Zilfaawi is an iambic variety of Arabic; therefore, feet are right-headed, respecting the constraint RH-TYPE=I (32).

(32) RH-TYPE=I   (Kager, 1999)
Feet have final prominence.

Negev Arabic can also be identified as iambic, as reported by Hayes (1995) and based on the examples in Blanc (1970).

Grouping the two final syllables into a foot and stressing the final syllable in Negev or Zilfaawi is not possible because of the high-ranking general constraint NON-FINALITY, which militates against having stress on the final syllable of the PrWd.

(33) NONFINALITY (NON-FIN):   (Prince & Smolensky, 2002)
No prosodic head is final in PrWd.

(34) Negev Arabic

	/ʔaxað-ah/	RH-TYPE=I	NON-FIN
a.	ʔa.(xa.ðáh)		*!
☞b.	(ʔa.xá)ðah		

(35) Zilfaawi Arabic

	/ʔaxað-ah/	RH-TYPE=I	NON-FIN
a.	ʔa.(xa.ðáh)		*!
☞b.	(ʔa.xá)ðah		

In Negev and Zilfaawi Arabic, words with four or more light syllables have stress on the antepenultimate syllable, respecting the constraint ALL-FEET-LEFT (36), which is obeyed by the trisyllabic words in the tableaux above. This constraint is a gradient constraint that measures the distance between the foot and the left edge of the word in syllables. (Extrametricality is indicated by angled brackets.)

(36) ALL-FEET-LEFT: (Adapted from Kager, 1999)
Every foot stands at the left edge of the PrWd.

(37) Negev: [za.lá.ma.tak] 'your man'

	/zalamatak/	RH-TYPE=I	NON-FIN	ALL-FEET-L
a.	za(lamá).ta\<k\>			*!
☞b.	(za.lá)ma.ta\<k\>			

(38) Zilfaawi: [ʔa.χá.ði.tih] 'she took it'

	/ʔaχað-at-ih/	RH-TYPE=I	NON-FIN	ALL-FEET-L
a.	ʔa.(χa.ðí).ti\<h\>			*!

☞b.	(ʔa.χá)ði.ti\<h\>			

The effect of the constraint ALL-FEET-L can also be seen in Jordanian Arabic. If we consider the word [ká.ta.bu] 'they wrote,' where the foot consists of the last two syllables, this candidate will be ruled out for violating ALL-FEET-L as in (39b).

(39) Jordanian: [ká.ta.bu] 'they wrote'

	/katab-u/	RH-TYPE=T	NON-FIN	ALL-FEET-L
a.	(ka.tá)bu	*!		
b.	ka.(tá.bu)			*!
☞c.	(ká.ta).bu			

If we have a word that contains a final heavy syllable (CVV) or (CVCC), NON-FIN and ALL-FEET-L will be violated to satisfy the undominated constraint weight-to-stress principle (WSP) (40), which enforces quantity sensitivity in all three languages. This constraint will be violated whenever stress is placed on a non-heavy syllable. The syllable structure CVC is considered light because the last consonant is extrametrical in all three languages and thus it does not contribute to weight. This extrametricality of the final consonant is enforced by the constraint FINAL-C-EM (41).

(40) WEIGHT-TO-STRESS PRINCIPLE (WSP):   (Prince & Smolensky, 2002)
Heavy syllables are stressed.

(41) FINAL-C-EXTRAMETRICAL (FINAL-C-EM):
Final consonants are extrametrical.

The constraints WSP and FINAL-C-EM must outrank NON-FIN to derive the correct output. Tableaux (42–44) demonstrate how these constraints compete with each other to derive the optimal outputs in the three dialects.

(42) Negev: [ʁa.na.máːt] 'sheep, individuals'

	/ʁanamaːt/	WSP	FINAL-C-EM	RH-TYPE=I	NON-FIN	ALL-FEET-L
a.	(ʁa.ná).maː\<t\>	*!				
b.	ʁa.na.(máːt)		*!		*	**
☞c.	ʁa.na.(máː\<t\>)				*	**

(43) Jordanian: [ʃa.ǰa.ráːt] 'trees'

	/ʃaǰar-aːt/	WSP	FINAL-C-EM	RH-TYPE=T	NON-FIN	ALL-FEET-L
a.	(ʃá.ǰa).raː\<t\>	*!				
b.	ʃa.ǰa.(raːt)		*!		*	**
☞c.	ʃa.ǰa.(raː\<t\>)				*	**

(44) Zilfaawi: [ʔu.ma.ráːk] 'your princes'

	/ʔumaraː-k/	WSP	FINAL-C-EM	RH-TYPE=I	NON-FIN	ALL-FEET-L
a.	(ʔu.má).raː\<k\>	*!				
b.	ʔu.ma.(ráːk)		*!		*	**
☞c.	ʔu.ma.(ráː\<k\>)				*	**

If we have more than one heavy syllable, stress will fall on the rightmost heavy syllable to satisfy the constraint RIGHTMOST (RM,H).

(45) RIGHTMOST (RM,H):

The head foot is the rightmost heavy syllable in PrWd.

   This constraint is undominated in all three dialects. In tableaux (46–48), output (a) is ousted in each case by virtue of not stressing the rightmost heavy syllable. The optimal candidate (b) bests its rival (a) in each tableau via the satisfaction of the RM,H constraint.

(46) Negev: [ba.ʃib.ríj.jah] 'by the knife'

/ba-ʃibrijjah/	WSP	Final-C-EM	(RM,H)	RH-TYPE=I	NON-FIN	ALL-FEET-L
a. ba.(ʃíb).rij.ja\<h\>			*!			*
☞b. ba.ʃib.(ríj).ja\<h\>						**

(47) Jordanian: [ħaːm.líːn] 'carrying, active participle, MASC'

/ħaːmil-iːn/	WSP	FINAL-C-EM	RM,H	RH-TYPE=T	NON-FIN	ALL-FEET-L
a. (ħáːm)liː\<n\>			*!			
☞b. ħaːm.(líː\<n\>)					*	*

(48) Zilfaawi: [ħaːm.líːn] 'carrying, active participle, MASC'

/ħaːmil-iːn/	WSP	FINAL-C-EM	RM,H	RH-TYPE=I	NON-FIN	ALL-FEET-L
a. (ħáːm)liː\<n\>			*!			
☞b. ħaːm.(líː\<n\>)					*	*

   In disyllabic words with light syllables, the three languages differ in placing stress. In Jordanian, stress falls on the first syllable to satisfy the high ranking constraints RH-TYPE=T and NON-FIN:

(49) Jordanian Arabic: [kátab] 'he wrote'

/katab/	WSP	FINAL-C-EM	RM,H	RH-TYPE=T	NON-FIN	ALL-FEET-L
a. (ka.tá\<b\>)				*	*	
☞b. (ká.ta\<b\>)						

   However, although Negev and Zilfaawi are iambic dialects, they exhibit some differences in placing stress in disyllabic words. This difference is due to the distinction between nouns and verbs in Zilfaawi, where stress falls on the final syllable of verbs but on the first syllable of nouns. Thus, there must be a higher constraint in the grammar of Zilfaawi that outranks the RH-TYPE=I constraint, thereby resulting in this distinction. I argue that this high-ranking constraint is the indexed constraint NON-FINALITY$_{NOUN}$ (50), which requires disyllabic nouns to have initial stress. This indexed constraint is very high in the grammar of Zilfaawi Arabic because no disyllabic noun surfaces with final stress.

   (50) NON-FINALITY$_{NOUN}$ (NON-FIN$_{NOUN}$):

Stress never falls on the last syllable of nouns.

(51) Zilfaawi Arabic: [ʁá.nam] 'sheep'

/ʁanam/	WSP	FINAL-C-EM	RM,H	NON-FIN$_{NOUN}$	RH-TYPE=I	NON-FIN
a. (ʁa.ná\<m\>)				*!		*
☞b. (ʁá.na\<m\>)					*	

However, verbs surface with stress on the final syllable, satisfying the RH-TYPE=I constraint. Therefore, the RH-TYPE=I constraint must outrank the general NON-FIN constraint, as the tableau below demonstrates.

(52) Zilfaawi: [ʔa.χáð] 'he took'

/ʔaχað/	WSP	FINAL-C-EM	RM,H	NON-FIN_NOUN	RH-TYPE=I	NON-FIN
a. (ʔá.χa<ð>)					*!	
☞b. (ʔa.χá<ð>)						*

In Negev, on the other hand, both nouns and verbs have stress on the last syllable, respecting the constraint RH-TYPE=I, which dominates NON-FIN as in the following tableaus.

(53) Negev Arabic: [ki.táb] 'he wrote'

/katab/	WSP	FINAL-C-EM	RM,H	RH-TYPE=I	NON-FIN	ALL-FEET-L
a. (kí.ta<b>)				*		
☞b. (ki.tá<b>)					*	

(54) Negev Arabic: [ʁa.nám] 'sheep'

/ʁanam/	WSP	FINAL-C-EM	RM,H	RH-TYPE=I	NON-FIN	ALL-FEET-L
a. (ʁá.na<m>)				*!		
☞b. (ʁa.ná<m>)					*	

In this section, I developed an analysis of the stress systems of these three dialects. Although the dialects share many features, Negev and Zilfaawi are iambic varieties of Arabic while Jordanian Arabic prefers trochaic feet.

4.2 High vowel syncope and low vowel raising

Two short vowel processes are accounted for in this section, namely high vowel syncope and low vowel raising. Syncope is a general process that targets high vowels in non-final open syllables in all three dialects, while raising targets low vowels in the same environment in Negev and Zilfaawi, but not in Jordanian Arabic, as seen above.

Because I argue that high vowel deletion and low vowel raising are not motivated by constraints such as Nuc/x proposed by Gouskova (2003), I argue that deletion and raising are both non-metrical reduction processes motivated by the constraint REDUCE (Kirchner, 1996; McCarthy, 2003) (55). Moreover, I argue that these three dialects differ in ranking the constraint REDUCE with respect to the other faithfulness constraints, which results in different vowel alternations in these dialects of Arabic.

(55) REDUCE: (Adapted from McCarthy, 2003)

A short vowel in a non-final open syllable has zero duration. Assign one violation mark for each increment of duration above zero on the scale Duration.

This constraint militates against any short vowel in a non-final open position by minimizing the duration of that short vowel. The scalar dimension (scale Duration) is as follows:

(56) a > i > Ø

The low vowel /a/ is the longest on this scale, while Ø is the shortest and the high vowel /i/ is in the middle between these two, /a/ and Ø (Kirchner, 1996; McCarthy, 2003). Thus, having a low vowel incurs two violations of this constraint, while having a high vowel incurs only one. To best satisfy this constraint, the vowel needs to delete.

The high vowel syncopates in all three dialects; therefore, the constraint REDUCE must outrank the faithfulness constraint MAX-high.

(57) MAX-high:
The vowel feature [high] in the input has a correspondent in the output.

The interaction of the two constraints is exemplified in tableaux (58–60):

(58) Zilfaawi Arabic: [ká:t.bih] 'a writer, FEM'

	/[ka:tib-ih]/	REDUCE	MAX-high
a.	(ká:)ti.bi\<h\>	*!	
☞b.	(ká:t)bi\<h\>		*

(59) Negev Arabic: [ná:glih] 'transporting, active participle, FEM'

	/na:gil-ih/	REDUCE	MAX-high
a.	(ná:)gi.li\<h\>	*!	
☞b.	(na:́g)li\<h\>		*

(60) Jordanian Arabic: [ka:́tbeh] 'a writer, FEM'

	/ka:tib-eh/	REDUCE	MAX-high
a.	(ka:́)ti.be\<h\>	*!	
☞b.	(ka:́t)be\<h\>		*

Candidate (a) is ruled out in each case because it incurs a fatal violation of the dominating constraint REDUCE. On the other hand, candidate (b) in each of the tableaux is optimal because it satisfies the high-ranking constraint REDUCE by incurring minimal violations of the faithfulness constraint MAX-high.

However, because the low vowel is not deleted in all three languages, there must be some higher constraint that protects the low vowel from the effect of the general constraint REDUCE. This is the faithfulness constraint MAX-low (61), which outranks the constraint REDUCE in the grammar of all these dialects.

(61) MAX-low:
The vowel feature [low] in the input has a correspondent in the output.

This is illustrated in the tableaux below, which show the effect of this ranking on all three dialects.

(62) Zilfaawi Arabic: [sá:.ʕa.dat] 'she helped'

	/sa:ʕad-at/	MAX-low	REDUCE	MAX-high
a.	(sá:ʕ).da\<t\>	*!		
☞b.	(sá:)ʕa.da\<t\>		**	

Here, candidate (a) is not optimal because it incurs a fatal violation of the high-ranking constraint MAX-low by deleting the low vowel. Candidate (b) is optimal because it incurs a minimal violation of the constraint REDUCE to satisfy the dominating constraint MAX-low.

(63) Negev Arabic: [zalámah] 'a man'

	/zalamah/	MAX-low	REDUCE	MAX-high
a.	(zál).ma\<h\>	*!		
☞b.	(zalá).ma\<h\>		****	

In this case, candidate (a) is ruled out due to the fatal violation of MAX-low. Candidate (b) incurs minimal violation of the markedness constraint REDUCE to satisfy the high ranking faithfulness constraint MAX-low.

(64) Jordanian Arabic: [muħ.tá.ra.ma] 'respectable, FEM'

/muħtarama/	MAX-low	REDUCE	MAX-high
a. muħ.(tár).ma	*!		
☞b. muħ.(tá.ra).ma		****!	

Under this ranking (65), the high vowel syncopates while the low vowel is protected in all dialects.

(65) MAX-low >>REDUCE >>MAX-high

However, the low vowel is not completely protected in Negev and Zilfaawi Arabic. There are some words where the low vowel raises to /i/. Thus, REDUCE must outrank the faithfulness constraint IDENT-low:

(66) IDENT-low:

Featural specification for [low] must be preserved in the input/ output mapping.

This is illustrated in the following tableaus:

(67) Zilfaawi Arabic: [míʃ.ti.ʁil] 'working, active participle, MASC'

/miʃtaʁil/	MAX-low	REDUCE	IDENT-low	MAX-high
a. (míʃ)taʁi<l>		**!		
☞b. (míʃ)tiʁi<l>		*	*	

(68) Negev Arabic: [míʃ.ti.ʁil] 'working, active participle, MASC'

/miʃtaʁil/	MAX-low	REDUCE	IDENT-low	MAX-high
a. (míʃ)taʁi<l>		**!		
☞b. (míʃ)tiʁi<l>		*	*	

Candidate (a) in each of these tableaux is ruled out because it incurs two violations of REDUCE by having a low vowel in a non-final open syllable. However, candidate (b) is optimal because it incurs minimal violation of the faithfulness constraint IDENT-low by raising the low vowel to /i/. A candidate like [(míʃ).tʁil] will be ruled out by MAX-low.

The low vowel /a/ raises to the high vowel /i/ rather than /u/ in most cases in both Zilfaawi and Negev Arabic. I assume that this choice is an effect of the universal markedness hierarchy (69) proposed by Lombardi (2003):

(69) *[+round] >> *[-round]   (Lombardi, 2003)

However, if the vowel is preceded or followed by the glide /w/, raising will be to the high round vowel /u/ exhibiting rounding assimilation between the glide /w/, which has the feature [round], and the preceding or following high vowel as in the following examples:

(70) Zilfaawi Arabic
a.   [ʃuwaˑrib]   'cupboards'
b.   [wugáft]   'I stood'
(71) Negev Arabic
a.   [ʃuwaˑrib]   'moustaches'
b.   [wugáf]   'he stood'

So, the unrounded high vowels get rounded to satisfy the constraint AGREE(+round) (72), violating the constraint *[+round] as in tableau (73).

(72) AGREE(+round):   (Adapted from Lombardi, 1999)
   Adjacent output segments have the same value of the feature (+round).

(73) Negev and Zilfaawi Arabic:

/ʃawa:rib	AGREE(+round)	REDUCE	*[+round]
a. (ʃi.wa:)ri\<b\>	*!		
☞b. (ʃu.wa:)ri\<b\>			*

Conversely, the low vowel in Jordanian Arabic cannot be raised as in the other two dialects. Therefore, the faithfulness constraint IDENT-low must outrank REDUCE, as well as MAX-low, in the grammar of Jordanian Arabic:

(74) MAX-low, IDENT-low >>REDUCE >>MAX-high

As a result, the low vowel has to surface faithfully to satisfy both faithfulness constraints, namely MAX-low and IDENT-low. The following tableau illustrates the role of this ranking to protect the low vowel from deletion or raising processes in the grammar of Jordanian Arabic.

(75) Jordanian Arabic: [ká.ta.bu] 'they wrote'

/katab-u/	MAX-low	IDENT-low	REDUCE	MAX-high
a. kát.bu	*!		*	
b. kí.ti.bu		*!*	**	
☞c ká.ta.bu			****	

Here, candidates (a) and (b) incur fatal violations of the constraints MAX-low and IDENT-low, respectively. Candidate (c) is chosen as the winner because it satisfies the high ranking faithfulness constraints by minimally violating REDUCE.

The re-ranking of the faithfulness constraints MAX-high, MAX-low, and IDENT-low above or below the markedness constraint REDUCE will produce two different grammars: One that allows the high vowel to delete and the low vowel to raise (76), as in Negev and Zilfaawi Arabic, and another that forces the high vowel to delete but protects the low vowel from any raising or deletion (77), as in Jordanian Arabic.

(76) MAX-low>>REDUCE>>IDENT-low, MAX-high
(77) MAX-low, IDENT-low>>REDUCE>>MAX-high

4.2.1 *The effect of guttural sounds as blockers*

Although Negev and Zilfaawi Arabic do raise the vowel, as demonstrated above, this raising process does not apply everywhere in the two dialects. Low vowel raising is blocked when the vowel is preceded by one of the guttural sounds /χ, ʁ, ʕ, ħ, ʔ, h/, as in the examples below.

(78) Zilfaawi Arabic
a.   [ʁá.nam]   *[ʁínam]   'sheep'
b.   [ħasáb.na]   *[ħisáb.na]   'we counted'

(79) Negev Arabic
a.   [χa.waːlah]   *[χi.waːlah]   'his uncles'
b.   [ʁadá]   *[ʁidá]   'lunch'

Thus, there must be some high-ranking constraint that militates against raising the low vowels in this specific environment. This constraint, which I call GUTLOW (80), requires the short vowel in a non-final open syllable to be low when it is preceded by one of the guttural segments /χ, ʁ, ʕ, ħ, ʔ, h/.

(80) GUTTURALLOW (GUTLOW):

Assign one violation mark for every high vowel that is preceded by a guttural sound, /χ, ʁ, ʕ, ħ, ʔ, h/.

A low vowel raises when it is followed but not preceded by a guttural consonant, as in the following:

(81) Zilfaawi Arabic

a.   [di.χíːl]   'a man who seeks protection'
b.   [ni.híːg]   'braying'

Let us reconsider the examples [ħasáb.na] 'we counted' and [ʁadá] 'lunch' in the following tableaux to see how the constraint GUTLOW interacts with the other relevant constraints in the grammar of Zilfaawi and Negev.

(82) Zilfaawi Arabic

/ħasab-na/	GUTLOW	REDUCE	IDENT-low
b. (ħi.sáb).na	*!	*	*
☞a. (ħa.sáb).na		**	

(83) Negev Arabic

/ʁada/	GUTLOW	REDUCE	IDENT-low
b. (ʁi.dá)	*!	*	*
☞a. (ʁa.dá)		**	

By identifying this hierarchy of constraints in the grammar of Negev Arabic and Zilfaawi Arabic (84), we are able to delete high vowels and raise, but not delete, low vowels. Moreover, low vowels adjacent to a guttural sound will surface faithfully. The rankings below will give us the different patterns:

(84) Zilfaawi and Negev Arabic:
GUTLOW>>MAX-low>>REDUCE>>MAX-high, IDENT-low

(85) Jordanian Arabic:
MAX-low, IDENT-low>>REDUCE>>MAX-high>>GUTLOW

The constraint GUTLOW is very low and outranked by other constraints in the grammar of Jordanian Arabic.

4.3 Low vowel deletion

In all three languages, low vowels are generally protected from processes like deletion by the faithfulness constraint MAX-low. However, there are two environments where low vowels delete in Zilfaawi Arabic. The first is when a low vowel occurs in a non-final light syllable followed by another non-final light syllable, as in the examples below.

(86) Zilfaawi Arabic:
a.   [**la.**ʕáb.na]   "we played"   c.   [ʁa.nám.ha]   "her sheep"

b. [lʕá.bat]   "she played"   d. [ʁní.mi]   "my sheep"

Observe that in words with more than two syllables, the first underlying low vowel /a/ does delete in (86b,d) because the following syllable is a non-final open syllable (/ʕa/ and /ni/, respectively). When the following syllable is heavy, as in [la.ʕáb.na] 'we played' or [ʁa.nám.ha] 'her sheep,' the low vowel does not delete.

The second environment in which a low vowel deletes is when the low vowel occurs in a non-final open syllable of a disyllabic word and is followed by a final CVC syllable, as in (87b,d).

(87)
a. [la.ʕáb.na]   "we played"   c. [saħábt]   "I pull"
b. [lʕáb]   "he played"   d. [sħáb]   "my sheep"

Thus, there must be some constraint above MAX-low that forces deletion of the low vowel in these specific positions.

In contrast to high vowel deletion, I argue that low vowel deletion is metrically driven in Zilfaawi Arabic. According to Kager (1999), vowel deletion and short vowel lengthening are two of the most common strategies implemented to enforce durational contrast between the syllables of an iambic foot. I argue that the iambic foot structure of Zilfaawi Arabic motivates deleting the low vowel of the unstressed syllable. I assume that the result of deletion is a moraless semisyllable, resulting in the foot shape ΔL (where Δ denotes a moraless syllable). The constraint responsible for the preference for uneven iambs is GROUPING HARMONY (GRPHARM) (88), which is proposed by McCarthy (2003) to account for another phenomenon in Bedouin Hijazi Arabic.

(88) GROUPING HARMONY (GRPHARM):   (McCarthy, 2003)
In an iambic foot (x, ʹy), |y| > |x|.   (|α| = weight of α in moras)

This constraint requires the bisyllabic foot to have a quantitative contrast between the two syllables. The foot shape preference in Zilfaawi Arabic is similar to the one proposed by Prince (1990) for iambic languages, with the addition of (Δ**L**):

(89) L**H**, Δ**L** ≻ **H**, LL ≻ **L**

Now let us take the input /laʕab-at/ 'she played' and see how we can get to the correct output form in the tableau below.

(90) Zilfaawi Arabic:

/laʕab-at/	GRPHARM	MAX-low	REDUCE	IDENT-low
a. (la.ʕá)ba\<t\>	*!		****	
b. la.(ʕá).ba\<t\>	*!		****	
☞c. (l.ʕá)ba\<t\>		*	**	

The failure of the suboptimal candidate (a) to delete the first low vowel results in a foot with two light syllables, which incurs a fatal violation of the constraint GRPHARM. Candidate (b) also violates GRPHARM because it has a monosyllabic foot with no contrastive syllables. In contrast, candidate (c) is optimal because it satisfies the dominating constraint GRPHARM by incurring a minimal violation of the constraint MAX-low. The surviving consonant /l/ together with the light syllable /ʕa/ constitute a perfect iambic foot (l.ʕa).

The other environment for deleting the low vowel is in disyllabic words when the light syllable is followed by a final CVC syllable. Let us consider the input /laʕab/ 'he played' in tableau (91).

(91) Zilfaawi Arabic:

/laʕab/	GRPHARM	MAX-low	REDUCE	IDENT-low
a.　(la.ʕá\<b>)	*!		**	
☞b.　(l.ʕá\<b>)		*		

Output (a) is ousted by virtue of not having an iambic foot structure with a contrastive quantity between the two syllables.

This metrical analysis of low vowel deletion in which the surviving consonant constitutes a moraless semisyllable to enforce the durational contrast within the foot is supported by several pieces of evidence in Zilfaawi Arabic.

First, because the first two syllables in words such as [la.ʕáb.na] 'we played' constitute a perfect contrastive iambic foot, (L**H**), no deletion occurs. The deletion of the low vowel in this case would incur a fatal violation of the constraint MAX-low, assuming that the foot (Δ**H**) is as good as (Δ**L**) or (L**H**), because it has an iambic foot with a contrastive quantity.

(92) Zilfaawi Arabic:

/laʕab-na/	GRPHARM	MAX-low	REDUCE	IDENT-low
a.　(l.ʕáb).na		*!		
☞b.　(la.ʕáb).na			**	

Second, Zilfaawi Arabic has a three-syllable stress window, where stress does not fall beyond the antepenultimate syllable. If we have words with the syllable structure CVCCCVCVC, we might syllabify them and assign stress as [ˈCVC.**C**CV.CVC] or [ˈCVC**C**.CV.CVC], respecting WSP and NON-FIN. However, this is not the case in ZA. Consider the following examples:

(93)
a.　/tarǰam/　　　　[tár.ǰam]　　　　　'he translated MASC'
b.　/tarǰam-at-ih/　[tar.ǰ.mí.tih]　　　'she translated it'

If the segment /ǰ/ is part of a consonant cluster in the coda or onset positions and it does not constitute a semisyllable by itself, we expect stress in (93b) to fall on the antepenultimate heavy /tar/, but it does not. That indicates that /ǰ/ is in the antepenultimate position in this case and it does constitute a semisyllable by itself, forming a perfect iambic foot with a durational contrast between the two syllables (ǰ.mí). Another example is /ʔinkasar-an/ [ʔin.(k.sá).ran] 'they broke, FEM'.

Third, if we look at all forms in Zilfaawi Arabic, we find that consonant clusters in onset positions never occur in the language except as a result of phonological processes such as vowel deletion. Furthermore, onset clusters may freely violate the sonority sequencing conditions (Selkirk, 1984) (in contrast to coda clusters, which are all of falling sonority):

(94) Zilfaawi Arabic:
a.　[n.kás]　　　　　'he returned"'
b.　[j.bás]　　　　　'he got dried'

While sonority sequencing constraints are presumably violable, clusters like those in (94) would not violate these constraints if they are actually not part of the same syllable. However, this is not an argument for the universality of sonority sequencing conditions. That the two consonants that surface in the onset position do not actually constitute a consonant cluster is not a new proposition. McCarthy (2003) proposed something similar in his analysis of vowel deletion in Bedouin Hijazi Arabic. Moreover, Cho and King (2003) suggested that complex segments in languages like Georgian and Polish are not actually consonant clusters, but rather belong to semisyllables and hence do not violate the sonority sequencing principle.

In contrast to Zilfawi, Negev and Jordanian Arabic do not exhibit foot structure preferences. The grouping harmony constraint GRPHARM has no effect in the grammar of Negev Arabic, where having an iambic foot of two syllables with the same weight is completely acceptable, as we see in the example [sibálah] 'an ear of corn'. Hence, the constraint GRPHARM must be outranked by MAX-low:

(95) Negev Arabic

/sabalah/	GUTLOW	MAX-low	GRPHARM	REDUCE
a. (s.bá).lah\<h\>		*!		**
☞b. (sibá).la\<h\>)			*	***

In this case, candidate (a) is disqualified due to the fatal violation of the constraint MAX-low incurred by deleting the low vowel.

Because Jordanian Arabic is a trochaic variety of Arabic, GRPHARM, a constraint on iambic feet, plays no role. We therefore see the following rankings for the three dialects:

(96) Zilfaawi Arabic
GRPHARM>>MAX-low>>REDUCE

(97) Negev and Jordanian Arabic
MAX-low>>GRPHARM, REDUCE

5. Low vowel deletion blocking conditions

In this section, I will consider cases in which low vowel deletion is blocked despite appearing to meet the conditions to apply. However, I will argue that these cases actually involve one of the following conditions: the impossibility of having a glottal stop as a semisyllable, or disyllabic nouns with final stress.

Although deletion normally occurs in Zilfaawi Arabic when the low vowel appears in a non-final open syllable and is followed by another non-final open syllable or followed by a final CVC syllable, the low vowels in the following examples surface with no deletion although they meet the conditions for deletion.

(98) Zilfaawi Arabic:
a.   [[(ʔ**a**.χá.)ðan]   [*[(ʔ.χá.)ðan]   'they took, FEM'
b.   [[(ʔ**a**.ká)lat]   (*[(ʔ.ká)lat]   'she ate'
c.   [[(ʁ**á**.nam)]   [*[(ʁ.nám)]   'sheep'
d.   [[(χ**á**.dam)]   [*[(χ.dám)]   'servants'

In the above examples (106), one of two conditions is met: either the low vowel is preceded by a glottal stop in the onset of the same syllable, repeated below as (107), or the low vowel occurs in a disyllabic noun (108).

(99) Zilfaawi Arabic:
a.   [[(ʔ**a**.χá).ðan]   [*[(ʔχá).ðan]   'they took, FEM'
b.   [[(ʔ**a**.ká).lat]   (*[(ʔká).lat]   'she ate'

In these examples, the onset of the first syllable in which low vowel deletion is expected to take place is the glottal stop ʔ**.**

The other environment where the low vowel does not delete is when it appears in disyllabic nouns.

(100) Zilfaawi Arabic:

a.   [(ʁá.nam)]   *[(ʁ.nám)]   "sheep"

b.   [(χá.dam)]   *[(χ.dám)]   "servants"

Although the low vowel is followed by a final CVC syllable in (108a, b), the vowel does not delete, in contrast to the verbs [lʕáb] 'he played' and [sħáb] 'he pulled' in Zilfaawi Arabic. Let us see how we can fit these blocking cases of low vowel deletion into our analysis.

5.1 Analysis of Blocking of low vowel deletion

Although in Zilfaawi Arabic deletion normally takes place in trisyllabic words that have two light syllables in a row, some words with non-final LL feet in Zilfaawi Arabic do not undergo deletion.

(101)

a.   /ʔakal-at/   [(ʔa.ká).lat]   'she ate'

b.   /ʔaχað-an/   [(ʔa.χá.)ðan]   'they took, FEM'

c.   /ʔumara/   [(ʔu.má)ra]   'princes'

Thus, there must be a constraint above GRPHARM in the grammar of Zilfaawi Arabic that blocks the deletion of the low vowel in these cases. I propose that this constraint is *ʔ-SEMISYLLABLE (123), which militates against having a semisyllable with a glottal stop as an onset:

(102) *ʔ-SEMISYLLABLE (*ʔ-SEMI)

No semisyllable with a glottal stop as an onset.

This means that glottal stops cannot constitute moraless semisyllables by themselves, as other consonants do in Zilfaawi Arabic.

It is not unusual for the glottal stop not to participate in phonological processes in languages. For example, in many languages, glottal stops do not accept secondary articulations such as rounding and palatalization (Bessell, 1992). Moreover, the glottal stop might not be strong enough to constitute a semisyllable by itself. Hiller (1998), as cited in Féry (2003), states that laryngeals (ʔ, h) are weak consonants due to being low in sonority. Let us now consider the input /ʔaχað-an/ 'they took, FEM' and the relevant candidates in the following tableau.

(103) Zilfaawi Arabic

/ʔaχað-an/	*ʔ-SEMI	GUTLOW	GRPHARM	MAX-low	REDUCE	IDENT-low
a. (ʔ.χá)ða\<n\>	*!			*	**	
☞b. (ʔa.χá)ða\<n\>			*		****	

Here, candidate

(a) Is ruled out since it fatally violates the constraint *ʔ-SEMISYLLABLE.

The other low vowel deletion blocking case is when the word is a disyllabic noun as in [ʁánam] 'sheep.' This blocking is due to the high-ranking indexed constraint NON-FIN_NOUN, which prohibits placing stress on the final syllable of nouns.

(104) Zilfaawi Arabic:

/ʁanam/	*ʔ-SEMI	GUTLOW	NON-FIN_NOUN	GRPHARM	MAX-low
a. (ʁ.ná\<m\>)			*!		*
☞b. (ʁána\<m\>)				*	

Candidate (a) incurs a fatal violation of the constraint NON-FIN$_{NOUN}$ for having stress on the last syllable. A possible candidate such as [(ɡ́.na<m>)] is going to be ruled out due to the fatal violation of GRPHARM and RH-TYPE=I.

Nevertheless, having this indexed constraint above GRPHARM does not prevent verbs from surfacing with stress on the last syllable to satisfy the GRPHARM constraint, as in the tableau below.

(105) Zilfaawi Arabic:

/laʕab/	*ʔ-SEMI	GUTLOW	NON-FIN$_{NOUN}$	GRPHARM	MAX-low	NON-FIN
a. (la.ʕá<b>)				*!		
☞b. (l.ʕá<b>)						*

Here, candidate (a) is ruled out for having an (LL) foot.

However, in disyllabic nouns that have a final heavy syllable, stress is placed on the final heavy syllable in Zilfaawi Arabic violating NON-FIN$_{NOUN}$ because the WSP constraint is undominated in the grammar and hence outranks NON-FIN$_{NOUN}$.

(106) Zilfaawi Arabic

/ʔumara:-k/	WSP	*ʔ-SEMI	GUTLOW	NON-FINNOUN	GRPHARM	MAX-low
a. (ʔumá)ra:<k>	*!			*	*	
☞b. ʔu(ma.ra:́<k>)				*		

Candidate (a) satisfies the NON-FIN$_{NOUN}$ constraint at the expense of fatally violating the other metrical constraint, WSP.

By exhibiting this metrical deletion and its blocking conditions, Zilfaawi Arabic provides additional evidence of rhythmic deletion, which enhances the durational contrast between the syllables of the feet. Other languages enforce the same requirement by other strategies. Some lengthen the vowel of the stressed syllable, as in Choctaw (Hyde, 2003) and Hixkaryana, which stress every even-numbered syllable from left to right except the final syllable (Bakovic, 1996; Kager, 1999):

(107) Hixkaryana:
a.   /qajani/   [(qaja:)ni]   'his own kayak'
b.   /atʃowowo/   [a.tʃó:).wo.wo]   'wind'

Other languages delete the vowel of the weak position of the foot, as in Aguaruna (Alderete, 1999) (108) and Bedouin Hijazi Arabic (109):

(108) Aguaruna:
/itʃinakana/   [(i.tʃĩ)(nΔ.ká)nΔ]   'pot, acc'

(109) Bedouin Hijazi Arabic:
/ʔinkasar-at/   [ʔin.(kΔ.sá).rat]   'it broke'

Moreover, Yupik (Broselow et al., 1997; Sprouse, 1996) exhibits an interesting strategy to enforce the durational contrast in the iambic feet, which are constructed from left to right. Yupik enforces the durational contrast between the syllables of the foot by lengthening the prosodic head of the foot:

(110) Yupik:
/ataka/   [(ata:́)ka]   'my father'

The coda consonant shares a mora with the preceding vowel in Yupik. However, if the syllable in the head position is CVC, the vowel does not lengthen but the coda consonant in the syllable CVC contributes to weight by bearing its own mora as in the following:

(111) Yupik:
(át)ma(kutáx)(tután)   'you're going to backpack'

So, the coda of a CVC syllable may be realized as a shared mora or moraic coda depending on its position in the foot (Broselow et al., 1997).

These iambic lengthening and deletion processes are sometimes blocked by metrical constraints. For example, in Hixkaryana (Kager, 1999) and Bedouin Hijazi Arabic (McCarthy, 2003), lengthening of the final vowel in the former and deletion of the weak syllable's vowel in the latter are blocked to satisfy the higher prosodic constraint, NON-FIN:

(112) Bedouin Hijazi Arabic:
/laʕab/   [(láʕa\<b\>)]   *l.ʕáb   'he played'

(113) Hixkaryana:
/kʷaja/   [(kʷá:).ja]   *[(kʷa.já:]   'red and green macaw'

However, Zilfaawi Arabic, as we saw above, makes an interesting distinction between nouns and verbs in the language by ranking GRPHARM higher than the prosodic constraints above the general constraint NON-FIN but lower than the indexed constraint NON-FIN$_{NOUN}$.

In contrast to Zilfaawi Arabic, Negev Arabic does not exhibit any differentiation between disyllabic nouns and verbs. Stress falls on the final syllable in disyllabic words, respecting the undominated constraint RH-TYPE=I, which outranks the NON-FIN constraint in the grammar of the language.

(114) Negev Arabic: [ʁa.nám] 'sheep'

/ʁanam/	RH-TYPE=I	GUTLOW	NON-FIN	MAX-low	REDUCE
a. (ʁá.na\<m\>)	*!				**
☞b. (ʁa.ná\<m\>)			*		**

(115) Negev Arabic: [ʃi.ríb] 'he drank'

/ʃarib/	RH-TYPE=I	GUTLOW	NON-FIN	MAX-low	REDUCE
a. (ʃĩ.ri\<b\>)	*!				*
☞b. (ʃi.rí\<b\>)			*		*

On the other hand, Jordanian Arabic is a trochaic variety of Arabic that never stresses the final light syllable.

6. Conclusions

The phonological processes that target short vowels in Zilfaawi, Negev, and Jordanian Arabic are metrically and non-metrically driven. I argue that both high vowel deletion and low vowel raising are non-metrical. They do not result from the interaction of either metrical constraints or general constraints against marked vowels in specific positions such as NUC/x. Both processes are triggered by the reduction requirement enforced by the markedness constraint REDUCE. All three dialects differ in ranking of the constraint REDUCE with respect to the other faithfulness constraints, which results in different vowel alternations in these three dialects of Arabic. In Zilfaawi and Negev Arabic, REDUCE causes the high vowel to delete and the low vowel to raise, while it can only cause the high vowel to delete in Jordanian Arabic. One blocking condition, which restrict the effect of REDUCE in

Zilfaawi and Negev Arabic, has been examined. That blocking condition is that a low vowel cannot be raised when it is preceded by a guttural sound /χ, ʁ, ħ, ʕ, h, ʔ/ due to the constraint GUTLOW.

Although the markedness constraint REDUCE is unable to trigger deletion of the low vowel in all three dialects because it is outranked by the faithfulness constraint MAX-low, the low vowel undergoes deletion in the grammar of Zilfaawi Arabic. To account for that, I argue that low vowel deletion is metrical, which is enforced by the high-ranking constraint GRPHARM to enforce the quantitative contrast between the two syllables in the foot. However, the effect of the constraint is blocked when the onset of the low vowel is a glottal stop respecting the constraint *ʔ-SEMISYLLABLE. Another constraint that blocks the effect of GRPHARM on nouns, but not verbs, is NON-FIN$_{NOUN}$, which militates against having a noun with stress on the final syllable. Zilfaawi is an iambic variety of Arabic like Negev Arabic and Bedouin Hijazi Arabic (McCarthy, 2003), but differs from Negev Arabic, which does not respect NON-FIN at all, and Bedouin Hijazi Arabic, which respects NON-FIN in both nouns and verbs. Zilfaawi Arabic also provides additional evidence of a language that exhibits rhythmic deletion but makes a distinction in NON-FINALITY between disyllabic nouns and verbs.

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