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Consonant Clusters In Quranic Arabic*

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This work discusses the syllable structure of Quranic Arabic (QA), and some syllable related phonological phenomena. QA generally prohibits a cluster of consonants within a syllable. OT (Prince & Smolensky, 1993) provides a complete account of a seemingly paradoxical situation, since complex onsets in the underlying representations of some words as well as complex codas of some output forms exist in QA. It is argued that the syllable pattern CVCC, which is the only pattern that phonetically manifests a consonant cluster in QA, results from constraint interaction. Some constraints are undominated, such as Onset. Other constraints are dominated, such as *Complex Coda. For example, from the underlying form /mraʔah/ 'a woman' we derive the phonetic form [ʔim.ra.ʔah.] and from /kʌlbu/ 'the dog' we derive [ʔal.kalb.]. Underlying initial clusters are modified by the insertion of both a vowel and a glottal stop (the default consonant) due to undominated Onset and *Complex Onset, but a final cluster remains because any modification would violate *Phrase-final Tanween or *[v, -long]_φ.

0. Introduction

Quranic Arabic is the language of the Quran, the holy book of around a quarter of the world's population, about 1.5 billion Moslem people around the world. Phonetically, there is no difference between Quranic Arabic (QA henceforth) and Standard Arabic (SA henceforth), the language of learning, literature and the press of around 300 million people using Arabic as a first language. Phonologically, however, there are some differences between the two. For example, in QA there is a phonological process involving the addition of a central vowel followed by a glottal stop to the end of the syllable that ends with one of the following consonants: q ʔ b j d. This process does not take place in SA.

Regarding the syllable structure, there is no difference between QA and SA. I have syllabified the most part of the Quran and found no difference between the syllable patterns of QA and those of SA, as they were stated in Al-Ani, 1970.

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In this paper, I analyze some body of data from the Quran within the framework of Optimality Theory (OT henceforth), (Prince & Smolensky 1993), in order to show that QA has a constraint prohibiting a cluster of consonants within a single syllable. The analysis will show that OT provides a complete account of the restrictions imposed on the occurrence of some syllables in particular positions of the phrase, the occurrence of some segments in particular syllables, and the phonological processes that affect the syllable structure of QA. Prior to OT this would have been dealt with by appealing to a conspiracy of sets of rules.

The rest of the paper is organized as follows. In section 1, I provide some background information on some issues relevant to the syllable structure of QA. In this background, I present an overview of vowel and consonant inventories of QA and the stress rules. Phonological phenomena relevant to syllable structure (prothesis, paragoge, and apocope) will be presented in section 2. In section 3, I present the data and an analysis of the syllable structure of QA within the perspective of OT. Wherever I mention an example either in the data or elsewhere in the paper, I mention the number of the verse followed by the number of the chapter of the Quran from which the example has been taken. For the Arabic consonants that are not found in English, I use the letters and symbols shown in (2). As for distinguishing long vowels from short vowels, I double the symbol that represents the short vowel to indicate its long counterpart. Finally, in section 4, which is the conclusion of the paper, I summarize the issues raised in this paper.

1. Background

1.1 The Vowel System of QA

Among the simpler vowel systems in the languages of the world is the Arabic vowel system. It is composed of three pairs of vowels. The first pair is made up of two low front vowels /a/ and /aa/. The second pair is made up of two high front vowels /i/ and /ii/. Finally, the third pair is made up of two high back vowels /u/ and /uu/. Within each pair, the only difference between the two elements is that one is short and the

other is long. In addition, a central vowel motivated by certain phonological processes exists in QA. (1) illustrates the vowel system of QA.

(1) The vowel system of QA

i ii		u uu
	ə	
	a aa	

In Arabic syntax, the three vowels *u*, *i*, and *a* are used to mark case on nouns: nominative, genitive, and accusative case respectively.

1.2 The Consonant System of QA

The consonantal inventory of QA consists of 28 consonant phonemes. They can be classified as follows: eight stops; thirteen fricatives; one affricate; two nasals; two semi vowels; one lateral; and one trill. (2) illustrates the consonantal inventory of QA. The orthographic symbols are provided next to the phonemic symbols.

(2) The consonantal inventory of QA

	Bilabial	Labiodental	Interdental	Dental	Pharyngealized Dentals	Alveolar	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stops	b ب			t ت d د	ط ظ			k ك	q ق		ʔ ؀
Fricative		f ف	θ ث ð ذ	s س z ز	ص ظ		ʃ ش x خ ɣ غ			ʕ ع ħ ح	h ه
Affricate							j ج				
Trill						r ر					
Lateral						l ل					
Nasal	m م					n ن					
Semi-vowel	w و						y ي				

1.3 The Syllable Structure of QA

There are five syllable patterns in QA, as in (3).

(3) The syllable patterns of QA.

- a. CV bi 'by'
- b. CVC min 'of, from'
- c. CVV lii 'to me'
- d. CVVC baab 'a door'
- e. CVCC baʔθ 'resurrection'

In terms of heaviness, the heaviness scale of Kelkar's Hindi (Prince & Smolensky, 1993, p. 40) corresponds to that of QA, as in (4).

(4) Heaviness scale of QA

CVVC, CVCC > CVV, CVC > CV

(4) shows that there are three levels of heaviness for QA: superheavy (CVVC, CVCC); heavy (CVV, CVC); and light (CV).

1.4 The Stress Rules of QA

In this subsection, I adopt the stress rules of SA which are stated in Al-Ani 1970 p. 88.

Potentially, each full word in Arabic has one or more stresses. Function words such as clitics, however, are not stressed. The stressed syllable can have a primary stress [ˈ], secondary [ˌ], or weak - unmarked. The position of the stress is affected by the number and type of the syllables involved, as illustrated in (5).

(5) The stress rules of Arabic

a-When a word consists of a string of the CV type syllables, the first syllable receives the primary stress and the other syllables receive no stress.

kataba CV-CV-CV 'he wrote'

b- When a phrase contains only one heavy or superheavy syllable, the heavy or the superheavy syllable receives the primary stress, no matter where its position is, and the rest of the syllables receive no stress.

.ki.taab. CV-CVVC 'a book'

.ʔu.laa.ʔi.ka. CV-CVV-CV-CV 'those'

.yu.ʕal.li.ma.hu. CV-CVC-CV-CV-CV 'he teaches it'

c- When a phrase contains two or more heavy syllables, the heavy syllable nearest to the end of the phrase (the last syllable is not considered) receives the primary stress and the one closest to the beginning of the phrase receives the secondary stress.

.yu.ʕaa.di.lu.ʕ.kum. CV-CVV-CV-CVV-CVC 'they argue with you'

2. Phonological Phenomena Affecting the Syllable Structure of QA

In this section, I present the parameters of phonological phenomena manifesting in QA, and their effect on the syllable structure of QA.

2.1 Prothesis

Prothesis is the addition of a segment to the beginning of a word (Trask, 1996). In QA a glottal stop followed by a short vowel is added to the beginning of the words that begin, in their underlying representations, with a sequence of consonants (complex onset). This phonological process is necessary in order to satisfy the generalization in (6).

(6) A word may not begin with a consonant cluster. *#CC...

There are many nouns as well as verbs whose input forms begin with more than one consonant. For instance, each noun in (7) below begins, in its input form, with a complex onset. The output form of the noun includes a glottal stop followed by a short vowel added to the beginning of the word, as shown in (7).

(7)	Input	Output	Gloss
	.mra.ʔah.	.ʔim.ra.ʔah.	'a woman'
	.θnayn.	.ʔiθ.nayn.	'two'
	.nti.laaq.	.ʔin.ti.laaq.	'departure'

The input forms contain sequences that cannot form acceptable output syllables in QA, e.g. (*CCV or *CCVCC) (see the syllable patterns of QA in (3) above).

This phonological restriction is also evident in Arabic verbs. The imperative form of the three consonantal root verb begins with a complex onset. In the output form a glottal stop followed by a short vowel is added to the beginning of the word in order to break the complex onset and, consequently, to resyllabify the word into two syllables, as in (8).

(8)	Input	Output	Gloss
	.ktub.	.ʔak.tub.	'write'
	.qraʔ.	.ʔiq.raʔ.	'read'
	.drib.	.ʔid.rib.	'hit'

The addition of a glottal stop followed by a short vowel occurs not only in the words whose input forms begin with a cluster of consonants, but also in the words that come to begin with such a cluster by the addition of the definite article /l/. Any noun in Arabic can receive the prefix /l/ in order to be specified as definite. Recalling the fact that no word in Arabic begins with a vowel, we form another generalization in (9).

(9) Words may not begin with a vowel. *#V

Taking this generalization into consideration, together with the fact that the definite article in Arabic consists of only one segment (consonant /l/), we expect any noun to begin with a cluster of consonants whenever the noun is preceded by the definite article. To illustrate, we expect the output forms in (10b) for the indefinite nouns in (10a).

(10a)	Indefinite	Gloss	(10b) Definite
	.kalb.	'a dog'	*.lkalb.
	.qalb.	'a heart'	*.lqalb.
	.ki.taab.	'a book'	*.lki.taab.
	.bint.	'a girl.'	*.lbint.
	.ʔum.	'mother'	*.lʔum.
	.ʔuxt.	'sister'	*.lʔuxt.
	.qa.lam.	'a pen'	*.lqa.lam.

In order to satisfy the generalization in (6) above, a glottal stop followed by a short vowel is added to the beginning of each noun to be defined, so that the examples in (10b) above are resyllabified as in (11).

(11)	Definite	Gloss
	.ʔal.kalb.	'the dog'
	.ʔal.qalb.	'the heart'
	.ʔal.ki.taab.	'the book'
	.ʔal.bint.	'the girl'
	.ʔal.ʔum.	'the mother'
	.ʔal.ʔuxt.	'the sister'
	.ʔal.qa.lam.	'the pen'

2.2 Apocope

Apocope is the loss or omission of one or more segments from the end of a word (Trask, 1996). In QA, some vowels are deleted at the end of the phrase. This deletion is exclusively applied to short vowels. Long vowels are never deleted even if they occur at the end of the phrase.

The deletion of vowels reduces the number of the syllables of the word, since the consonant remaining after the deletion of the vowel joins to the preceding syllable. If the preceding syllable is open (i.e. it has no coda), then, the joining consonant will be the coda of that syllable. However, if the preceding syllable is closed (i.e. it already has a coda), then, the syllable will have a consonant cluster (a complex coda). (12a, and b) exemplify these two cases respectively.

	Input	Output	Gloss
(12a)	.fii.lki.taa.bi.	.fil.ki.taab.	'in the book'
(12b)	.fii.lbaħ.ri.	.fil.baħr.	'in the sea'

In QA, this is the only case where a cluster of consonant is allowed. In the next subsection, we will consider another phonological phenomenon preventing this cluster from occurring in non-final position.

2.3 Paragoge.

Paragoge is the addition of one or more segments to the end of a word (Trask, 1996). In QA, there are three types of paragoge. Firstly, the addition of an /n/ to the end of some nouns in particular environments. This phenomenon is known in the literature of Arabic as 'tanween'. Secondly, the addition of an /h/ to the end of some words in particular environments. This /h/ is known in the literature of Arabic as 'haʔ ʔas-sakt' 'h of silence'. Finally, there is a process known as 'ʔalqalqalah' which is the addition of a glottal stop preceded by a short vowel to the end of some syllables in particular environments.

2.3.1 The Paragoge of /n/ 'Tanween'

Traditional Arab grammarians consider the phenomenon of 'tanween' as an /n/ added to the end of the noun in pronunciation, not in writing, (Qamhawi, 1969). Practically, this /n/ is added to certain indefinite nouns in a non-final position only. Whenever the noun precedes a pause, the /n/ disappears. Thus, this /n/ can be morphologically analyzed as a morpheme assigned to a certain group of indefinite nouns. However, such morpheme assignment is subject to certain phonological restrictions. In Arabic orthography, this /n/ is not represented by the regular letter for /n/, rather it is indicated by doubling the diacritic that represents the short vowel preceding the /n/. (13a) exemplifies the paragoge of /n/, indicated by underlining.

(13a) “.yax.lu.qu.kum. .fii. .bu.ʔuu.ni. .ʔum.ma.haa.ti.kum. .xal.qaħ. .min. .baħ.di. .xalq.” (6.39).

“He forms you in the mothers' abdomens, formation after formation...”

In this part of the verse 6 of the chapter 39 of the Quran, the noun 'xalq', which means 'formation or creation', appears twice. The first time, it is composed of two syllables, .xal.qaħ. CVC-CVC (let us call it the first word). The second time, it consists of one syllable, .xalq. CVCC, (let us call it the second word). The composition of two syllables is due to the paragoge of /n/, and to the existence of the

low short vowel (the accusative case marker) before /n/. This is because the first word (.xal.qan.) is not followed by a pause (i.e. it is not in final position).

Yet, when the second word 'xalq' occurs at the end of the phrase, it consists of one syllable only. This is due to the prohibition of the paragogic /n/ at the end of the phrase, on the one hand, and the deletion (apocope) of the final vowel, on the other hand. However, the second word can be resyllabified to become two syllables, like the first one. This will happen if we add another part from the verse to the example (13a), as in (13b).

(13b) “.yax.lu.qu.kum. .fii. .bu.tuu.ni. .ʔum.ma.haa.ti.kum. .xal.qan. .min. .baʔ.di. .xal.qin. .fii. .ʔu.lu.maa.tin. .θa.laaθ.” (6.39)

“He forms you in the mothers' abdomens, formation after formation in three veils of darkness.”

Since the second word is no longer at the end of the sentence, the paragogic /n/ is obligatory. Consequently, its syllable structure is changed from .xalq. to .xal qin.

To conclude this subsection, we can say that, within the phrase, a noun consisting of the syllable CVCC must be resyllabified into the sequence of the two syllables CVC-CVC due to the paragogic /n/, and to the parsing of a short vowel.

2.3.2 The Paragogic 'h'

The application of the paragogic 'h' involves verbs, nouns and pronouns. The consequence of this paragoge differs from one case to another, as can be seen in (14).

(14)	Input	Output	Gloss
a-	.sʕa.	.ʔis.ʕah.	'strive'
	.rmi.	.ʔir.mih.	'throw'
	.dʕu.	.ʔud.ʕuh.	'invite'
b-	.qi.	.qih.	'preserve'
	.ʕi.	.ʕih.	'perceive'
	.fi.	.fih.	'redeem'
c-	.ki.taa.bi.ya.	.ki.taa.bi.yah.	'my book'
	.hi.ya.	.hi.yah.	'she/it'
d-	.bi.ma.	.bi.mah.	'with what'
	.li.ma.	.li.mah.	'why'
	.ʕam.ma.	.ʕam.mah.	'about what'

In (14a), 'h' is added to the verb in order to avoid having a consonant cluster. From the previous subsection we know that a short vowel is deleted at the end of the word. When the 'h' is added the short vowel is kept, because it is no longer at the end of the word. 'h' and the short vowel together with the last consonant in the cluster form a new syllable.

In (14b), 'h' is added in order to satisfy word minimality in (15).

(15) A word must consist of more than one segment.

The deletion of the final short vowel leaves the prosodic word (the verb) with only one non-syllabic segment. Recall that there is no syllabic consonant in Arabic. The addition of 'h' provides the opportunity for the short vowel to appear and therefore, to be the nucleus of the syllable.

In (14c), the last syllable is a clitic, which might be expected to lose its nucleus (the short vowel) because it occurs at the end of the phrase. In Arabic, a clitic must

contain a full syllable. In order for the clitic to be a full syllable, an 'h' is added so that the 'h' and the light syllable form the heavy syllable CVC.

In (14d), the examples are prepositional phrases in which the first syllable represents the preposition and the second syllable represents the complement (the prepositional object). The input forms show that the second element of the phrase consists of one segment only since the short vowel is to be deleted. In order to protect the short vowel from deletion, an 'h' is added to form a complete closed syllable (CVC) representing the complement of the phrase.

In short, [h] insertion prevents short vowel deletion while vowel retention, in turn, prevents an illicit final cluster.

2.3.3 Alqalqalah: the insertion of a central vowel with a glottal stop

The application of this process involves only the syllables that end with one of the following sounds: q t b j d. The common feature among these sounds is that all are [-sonorant]. In addition, three of them, (b,j,d), are [+voice]. The other two, (q,t), are [+guttural], or [pharyngeal], in the framework of McCarthy (1994). In other words, they have marked characteristics. They might therefore be expected to undergo simplification in phrase-final position by the loss of voicing or pharyngeality. However, such loss does not occur. Instead, a central vowel followed by a glottal stop is added to the end of the phrase that ends with one of these sounds in the input, as shown in (16).

(16)	Input	Output	Gloss
	.fa.laq.	.fa.la.qəʔ.	'dawn'
	.la.hab.	.la.ha.bəʔ.	'flame'
	.ma.sad.	.ma.sa.dəʔ.	'palm-leaf fiber'
	.lbu.ruuj.	.ʔal.bu.ruu.jəʔ.	'constellations'
	.mu.hiit.	.mu..hiitəʔ.	'encompassing'

This process affects the syllable structure of the phrase, as can be seen in the examples in (16). The output form of each example has more syllables than the input. In addition, the coda of the last syllable of the phrase in the input form becomes the onset of the added syllable leaving the preceding syllable without a coda (open syllable). This phenomenon has nothing to do with consonant clusters; nonetheless, it is relevant because it has an influence on the syllable structure of QA.

3. Data and Analysis

In this section, I present data from the Quran. Then, I analyze the data within the framework of OT. The data are divided according to the number of the phonological phenomena, discussed in the previous section.

3.1 Phrases displaying prothesis

The following examples show the process of prothesis resulting in the addition of a glottal stop followed by a short vowel to the beginning of the words (verbs and nouns) that begin, in their underlying representations, with a cluster of consonants. Each of the underlined words shows a resyllabified form of an underlying representation with an initial consonant cluster. (17i), however, shows how a clitic can prevent a consonant cluster without the need for the process of prothesis.

(17) a- "wa.qaa.la.ti. mra.ʔa.tu.fir.ʃaw.na..qur.ra.tu..ʃay.nin..lii..wa.la.ka..laa..taq.tu.luu.hu...." (ʔim.ra.ʔa.tu) (9.28)

"The wife of Pharaoh said: (Here is) a joy of the eye, for me and for thee: Slay him not."

b- "...wa.min. kul.liθ.θa.ma.raa.ti. ja.ʃa.la. fii.haa. zaw.jay.ni. θnay.ni..." (ʔiθ.nay.ni) (3.13)

"...and fruit of every kind He made in pairs, two and two."

c- "...ʔin. haa.ðaa. ʔil.laa. xiti.laaq." (ʔix.ti.laaq) (7.38)

"This is nothing but a made-up tale."

d- "...ktub .la.naa. fii .haa.ði.hi. ddun.yaa .ña.sa.na.tan. .wa.fii. l?aa.xi.ra.ti..."
(?uk.tub.) (?ad.dun.yaa.) (?al.?aa.xi.ra.ti.) (156.7)

"...and ordain for us that which is good, in this life and in the Hereafter."

e- "qra? .bis.mi. .rab.bi.ka..." (?iq.ra?) (1.96)

"Read in the name of thy Lord."

f- "drib .bi.ña.saa.ka. lbah.ra..." (?id.rib.) (?al.bah.ra.) (63.26)

"Strike the sea with thy rod."

g- "fa.ma.θa.lu.hu. .ka.ma.θa.li. lkal.bi..." (?al.kal.bi.) (176.7)

"His similitude is that of a dog."

h- "tan.zii.lu. lki.taa.bi .mi.na. l?aa.hi .lña.zii.zi. lña.kiim" (?al.ki.taa.bi)
(?al.laa.hi.) (?al.ña.zii.zi.) (?al.ña.kiim.) (1.39)

"The revelation of this book is from Allah, the Exalted in power, full of wisdom."

i- "nuun. wal.qa.la.mi .wa.maa. .yas.ñu.ruun..." (?al.qa.la.mi.) (1.68)

"Swearing by Nun and the pen and the (record) which (men) write..."

j- "dxu.luu .ña.lay.hi.mu. lbaa.ba..." (?ud.xu.luu.) (?al.baa.ba.) (23.5)

"Assault them at the gate."

3.2 Phrases displaying apocope

The following examples show the process of apocope resulting in the loss of the short vowel from the end of the phrase. Each of the underlined words shows a resyllabified form of an underlying representation with a final short vowel. Notice that this process can lead to a consonant cluster as can be seen in (18b and c).

(18) a- "wa.qad. .nuz.zi.la. ña.lay.kum. fil.ki.taab." (fii .?al.ki.taa.bi.) (140.4)

"Already has He sent you in the book..."

b- "fa. ?al.qii.hi. fil.yamm" (fii .?al.yam.mi.) (7.28)

"Cast him into the river."

c- "hal. ?a.taa. ña.lal.?in.saa.ni. .hii.nun. mi.nad.dahr" (mi.nad.dah.ri.) (1.76)

"Has there not been over Man a long time...?"

3.3 Phrases displaying paragoge

The following examples show the process of paragoge resulting in the addition of an /n/ to the end of some nouns, (i.e. the phenomenon of 'tanween'), as in (19a). The addition of an /h/ to the end of some words, (i.e. 'ha? ?as-sakt' 'h of silence') as in (19b-d). Finally, the examples in (19e-i) show the addition of a glottal stop preceded by a central vowel to the end of some words, (i.e. the phenomenon of '?alqalqalah').

(19) a- "yax.lu.qu.kum. fii .bu.ñuu.ni. ?um.ma.haa.ti.kum. xal.qan .min. .bañ.di. xal.qin .fii. ðu.lu.maa.tin .θa.laaθ." (xal.qan.) (xal.qin.) (ðu.lu.maa.tin.) (6.39)

"He forms you in the mothers' abdomens, formation after formation, in three veils of darkness."

b- "haa. ?u.muq.ra. ?uu. ki.taa.bi.yah" (ki.taa.bi.yah.) (19.69)

"Ah here! Read ye my record."

c- "wa.maa. ?ad.raa.ka. maa.hi.yah" (maa.hi.yah.) (10.101)

"...and what will explain to thee what this is?"

d- "ñam.ma .ya.ta.saa. ?a.luun" (ñam.ma.) (1.78)

"Concerning what are they disputing?"

e- "rab.bil.fa.la.qə?" (?al.fa.la.qə?) (1.113)

"The Lord of the daybreak"

f- "naa.ran. .ðaa.ta. la.ha.bə?" (la.ha.bə?) (3.111)

"A fire of blazing flames"

g- "hab.lun. .mim. ma.sa.də?" (ma.sa.də?) (5.111)

"A rope of palm fibre"

h- "was.sa.maa. ?i. .ðaa.til.bu.ruu.jə?" (?al.bu.ruu.jə?) (1.85)

"By the heaven holding the big stars"

i- "wal.laa.hu. .miw. wa.raa. ?i.him. mu.hii.tə?" (mu.hii.tə?) (20.85)

"God encompasses them from behind"

3.4 Analysis

I begin this subsection by stating some observations on the syllable structure of QA.

3.4.1 Observations on the Syllable Structure of QA

The first observation is that all five syllable patterns in Arabic include an onset. The second observation is that three of the patterns (CVC, 3b, CVVC, 3d, and CVCC, 3e) have codas (i.e. they are closed syllables), and two of them (CV, 3a and CVV, 3c) do not (i.e. they are open syllables). The third observation is that while the second, the third and the fourth patterns occur initially, medially and finally, the first pattern (CV) does not occur finally or in isolation. This is because the second element of the syllable is short vowel, which is always deleted in final position. Finally, the fifth pattern (CVCC), however, occurs only finally or in isolation.

The data and the syllable patterns of QA reveal an avoidance of consonant clusters within one single syllable. The deletion of short vowels leads to a potential consonant cluster because the consonant remaining after the deletion must join to the preceding or the following syllable, in some cases forming a consonant cluster. Yet, there are phonological processes that protect a short vowel from deletion such as the process of 'tanween' (paragoge of /n/). However, when such a process fails to apply, a short vowel is deleted and, therefore, a consonant cluster is formed. The only case in which a consonant cluster is formed is the case of the fifth pattern CVCC. Two factors combine to create this consequence: the deletion of short vowel at the end of the phrase, and the prohibition of 'tanween' (paragoge of /n/) at the end of the phrase, (Compare between (13a) and (13b) above.)

These facts lead us to conclude that this syllable CVCC is not basic in QA. Rather, it results from the interaction of two constraints: the constraint that prohibits the paragoge /n/ at the end of the phrase (which would protect a final vowel from deleting), and the constraint that deletes the short vowel at the end of the phrase. In

order to exemplify this interaction, the bisyllabic CVC-CV input forms in (21) are provided.

(21)	i	ii	
input	Short vowel deletion	Resyllabification	gloss
a- .xal.qu ...	.xal.q	.xalq.	'creation'
b- .baʕ.θu ...	.baʕ.θ	.baʕθ.	'resurrection'
c- .nah.ru ...	.nah.r	.nahr.	'a river'
d- .bah.ru ...	.bah.r	.bahr.	'a sea'

Wherever one of these words occurs at the end of a phrase, the short vowel, which is the nucleus of the last syllable, must be deleted. Consequently, the stray consonant, which remains after the deletion of the short vowel, joins to the preceding syllable CVC to form a new syllable; that is, the syllable CVCC.

3.5 Constraints

The facts discussed in sections 2 and 3 can be accounted for by the following constraints which are divided into three sets: constraints concerning onset and coda, (22a, and b); constraints concerning onset only, (23a, and b); and constraints concerning coda only, (24a-c).

(22a) Fill.

"Syllable positions are filled with segmental material." (Prince & Smolensky, 1993, p 25)

This constraint militates against epenthesis. It is violated in QA in order to prevent consonant clusters and to avoid beginning a word with a vowel or ending a phrase with a short vowel. Thus, this constraint concerns both onset and coda.

(22b) *C [\check{v} +high]\$

No unstressed short high vowel in an open syllable.

This constraint is ranked highly in many modern Arabic dialects, such as Palestinian Arabic (see Abu-Mansour, 1994). However, this constraint is ranked lower in QA because satisfying it leads to a consonant cluster. It is satisfied only if a

short high vowel is deleted to satisfy $*\dots[v, -\text{long}]_{\phi}$, (*Phrase-final short vowel), (see the tableau (31)). The generalization responsible for the deletion of short vowels is applied to all the three short vowels in Arabic, including the low vowel, (a, i, u), and the deletion takes place only at the end of the phrase. Thus, the constraint in (22b) is active in QA only accidentally. The optimal candidate in the tableau (31) satisfies this constraint following the satisfaction of the undominated constraint $*\dots[v, -\text{long}]_{\phi}$ (Phrase-final short vowel).

(23a) Ons.

Every syllable must have an onset.

(23b) *Complex Onset.

Onsets must consist of no more than one consonant.

QA is like Yawelmani in that words begin with a single consonant. Archangeli (1997, p. 8) describes Yawelmani as follows: “*Yawelmani words begin with exactly one consonant...* Since each *syllable* necessarily begins with a consonant, each *word* also begins with a consonant (ONSET). Neither a vowel alone nor a vowel-consonant sequence is a syllable and so no word in the language can start with a vowel.” (Cf. the syllable patterns of QA in (3) above.)

(24a) *Complex Coda.

Codas must consist of no more than one consonant.

(24b) $*[v, -\text{long}]_{\phi}$

A short vowel is disallowed at the end of the phrase.

(24c) *Phrase-final ‘tanween’

Tanween is disallowed at the end of the phrase.

The satisfaction of the constraints in (24b, and c) leads to the violation of the constraint in (24a), since the deletion of short vowels leads, sometimes, to complex codas and the process of ‘tanween’, that can protect short vowels from deletion, is not allowed in a final position.

In what follows, I will show the possible interactions of the constraints in (22-24) with each other. This ultimately leads us to determine the dominance relationship among them, and to rank them hierarchically.

The output [ʔim.ra.ʔah.] shows that Ons and *Complex Ons must dominate Fill. Consider the tableau (25).

(25) Ons and *Complex Ons >> Fill, from /mra.ʔah/.¹

Candidates	Ons	*Complex Ons	Fill Ons	Fill Nuc
a. \emptyset □ m.ra.ʔah.			*	*
b. □ m.ra.ʔah.	*!		*	*
c. .mra.ʔah.		*!		

The symbol □ indicates an empty position, and the periods indicate syllable edges. The function GEN provides us with a great number of candidates analyses for the input, among which are the three candidates given in (25). Candidate (25a) violates both Fill_{Ons} and Fill_{Nuc} in order to satisfy the constraint against complex onsets. Candidate (25b) violates both Fill and Ons. Candidate (25c) would satisfy the constraint against *complex onsets but at the expense of *#V. Since both of the constraints related to onset (i. e. Ons and *Complex Ons) are never violated in QA, and are therefore not dominated in the ranking, the optimal candidate is (25a). Consequently, Ons and *Complex Ons dominate Fill.

Tableau (25) shows that constraint Fill is dominated by constraints Ons and *Complex Ons. This is also an example of the prothesis of a glottal stop followed by a short vowel to a word. In a similar case, Prince & Smolensky 1993, have concluded that constraint Ons dominates Fill in Arabic. I agree with this conclusion, but I disagree with them with respect to the premises of that argument. In (26) I repeat their tableau (22) (Prince & Smolensky 1993, p. 26,) in order to show the point of disagreement.

¹ Another possible candidate is .m□.ra.ʔah. I assume that this is excluded by a constraint Contiguity, ranked above Fill Ons, stated in (i). This is based on McCarthy & Prince’s (1994) constraint Contiguity, stated to regulate the correspondence between Base and Reduplicant.

(i) Any element of O (Output) lying between elements of O with correspondents in I (Input) must have a correspondent in I.

(26) Ons >> Fill from /alqalamu/.

Candidates	Ons	Fill
□al.qa.la.mu		*
.al.qa.la.mu.	*!	
□al.qa□.la.mu.		**!
□al.qal.□a.mu.		**!
□al.qa□.la□.mu.		**!*
□al.qa□.la□.mu□.		**!***

(26) shows that the input form starts with a vowel, and in order to avoid the violation of the constraint Ons, an empty position must be inserted. This results in a violation of the constraint Fill. The second candidate is rejected because of the violation of the constraint Ons. The remaining candidates, from the third to the end, fail to be optimal, despite the satisfaction of the constraint Ons, ostensibly because they violate Fill more than once.

In short, having established that Fill is violated only to provide onsets, Prince & Smolensky argue that the optimal candidate is the first one (□al.qa.la.mu.) because it satisfies the constraint Ons and violates Fill only once.

I argue that the constraint *Complex Ons is also involved in the analysis of this example. This is based on the fact that the actual input is /lqa.la.mu./ not /al.qa.la.mu./ . In other words, the *a* is also epenthetic; it is not part of the input. To illustrate this point, let's analyze the output form in terms of its component parts. The phrase 'ʔalqalamu', which means 'the pen', is made up of two morphemes: the definite article 'ʔal', 'the', and the noun 'qalam', 'pen' (the last vowel /u/ is the nominative case marker). In Arabic literature there had been a debate over the composition of the definite article in Arabic. Logically, there are three possibilities for the composition of the definite article in Arabic. First, it may be seen as being composed of three segments: a glottal stop, a low front vowel, and a lateral consonant, i.e. 'ʔal-'. Second, it may be considered as being composed of a low front vowel and a lateral consonant, i.e. 'al-' (meaning that the ʔ is epenthetic). Finally, it

may be composed of a lateral consonant only 'l-'. In this case both the ʔ and *a* are epenthetic. The debate always focuses on the first and the third possibilities. The second possibility has never been a matter of debate because the generalization 'no word begins with a vowel' is considered to hold of the input level as well as the output level. Thus, the debate is actually, whether the Arabic definite article is 'ʔal-' or 'l-'. I hold that it is the second of these.

Referring to a text book '*Sharh Ibn Aqeel*' in Arabic grammar studied at the university level all over the Arabic countries, (Mohamed M. Abdulhamid, 1947), the definite article in Arabic is the lateral /l/ only. There are examples in the Quran to show that the first and second segments are dropped from the full form of the definite article 'ʔal' whenever a clitic precedes the definite article. Example (27) exemplifies this case.

- (27) a. .wa.l.qa.la.mi. → .wal.qa.la.mi. '...and the pen'
 b. .bi.l.qa.la.mi. → .bil.qa.la.mi. '...with the pen'

Clitics in Arabic, such as the conjunction 'wa' 'and', and the preposition 'bi' 'with/by', join to the following word and become a part of it prosodically, since clitics in Arabic do not contain a stressed syllable, and therefore are not prosodic words. The absence of ʔ and *a* in each of the examples in (27) indicates that they are not part of the input of the definite article. That is, the definite article is not */ʔal/. Rather, ʔ and *a* are epenthized at the beginning of the word in order to avoid having complex onset, eg. *lq, whenever a noun is to be defined. This would be a persistent problem since a word in Arabic must begin with a consonant. The low front vowel preceding /l/ in (27a) is not part of the definite article, but it is part of the conjunction 'wa'. If it were part of the definite article, it would appear in (27b) as well (i.e. *.bal.qa.la.mi.). Furthermore, if we put a clitic such as 'ðu' 'possessor', whose second element is a back high vowel, before the word *ʔalqalam*, the consonant /l/ will be preceded by the vowel of *ðu* 'possessor', in the expression *ðuʔalqalami* 'possessor of the pen', rather than /a/. Thus, in a definite noun such as *ʔalqalamu*, both /ʔ/ and /a/ are added to form an initial syllable CVC, in which the two added segments form the

onset and the nucleus of the syllable respectively, and the definite article /l/ surfaces as the coda of that syllable.

Taking into consideration the facts mentioned above, the tableau (26) should be rearranged in a way that includes the constraint *Complex Ons as well as Onset, and the constraint Fill must be divided into two constraints: Fill_{Ons} and Fill_{Nuc}, since the second epenthized segment is a vowel. Also, the candidates should be generated in a way that shows violation of the new set of constraints (i.e. *Complex Ons, Fill_{Ons} and Fill_{Nuc}). Finally, the hypothesis that says *Fill is violated only to provide onsets* should be replaced by the hypothesis that the constraint Fill can be violated more than once in order to satisfy the constraint *Complex Ons. With respect to multiple violation of the constraint Fill, Arabic is similar to Lardil. (For the Lardil case, see Prince & Smolensky 1994, chapter 7). The tableau in (28) gives an example for the suggestion mentioned above.

(28) *Complex Ons >> Fill in /ʔal.qa.la.mu./

Candidates	*Complex Ons	Ons	Fill _{Ons}	Fill _{Nuc}
☞ □□.qa.la.mu.			*	*
.lqa.la.mu.	!*			
.al.qa.la.mu.		!*		

The constraint *Complex Ons also dominates the constraint *C[\check{v} +high] in QA, although the contrary can be the case in many modern Arabic dialects, (see Abu-Mansour, 1994.) The following tableau exemplifies this domination in QA.

(29) *Complex Onset >> *C[\check{v} +high] from /ki.taab'./

Candidates	*Complex Onset	*C[\check{v} +high]
☞ a. ki.taab'		*
b. k<i>taab'	*!	

In tableau (29), the word *kitaab*, which means 'a book', is composed of two syllables, an open syllable followed by a closed syllable. The nucleus of the open

syllable is a short high vowel, and the stress falls on the second syllable, the closed one, because it is heavier than the first open syllable. The deletion of a short high vowel, would meet the demands of the constraint *C[\check{v} +high], but would violate the constraint *Complex Onset because the remaining consonant joins to the second syllable to form a single super heavy syllable *CCVVC with a complex onset (candidate b). However, syllables with complex onsets are not found in the syllable inventory of QA (recall the syllable pattern of QA in (3) above). Thus, the satisfaction of the constraint *C[\check{v} +high] would entail the creation of a disallowed syllable. The fact that short high vowel deletion does not occur indicates that *Complex Onset dominates *C[\check{v} +high] in QA.

The Consonant *C[\check{v} +high] is also dominated in QA by *Complex Coda, as illustrated in (30).

(30) *Complex Coda >> *C[\check{v} +high] from /ʔah.di.him'./

Candidates	*Complex Coda	*C[\check{v} +high]
☞ a. ʔa'h.di.him'		*
b. ʔahd.him'	*	

In tableau (30), candidate (30a) is composed of two closed syllables mediated by an unstressed open syllable with a short high vowel as its nucleus (CV'C.CV.CVC). The stress falls on the first syllable because it is heavier than the second syllable, and it occurs at the beginning of the word. This creates violation of the constraint *C[\check{v} +high]. Being composed of two closed syllables only, candidate (30b) satisfies *C[\check{v} +high] but at the expense of violating *Complex Coda. The first syllable of the candidate (30b) is of the fifth type (the pattern 3e) of the syllable inventory of QA. This syllable, which contains a complex coda, must not occur initially or medially. The violation of *Complex Coda initially or medially is prohibited in QA. This entails that candidate (30a) is the optimal candidate. Therefore, *Complex Coda dominates *C[\check{v} +high].

Despite the fact that constraint *Complex Coda is ranked highly in QA, there are optimal forms that show clear violation of this constraint. Tableau (31) exemplifies one such form, which results when a final short vowel cannot be realized.

(31) *[v, -long]_φ >> *Complex Coda from /hiinun mina ldahri/, 'a period of time'.

Candidates	*[v, -long] _φ	*C[^v +high]\$,	*Complex Coda
a. .?ad.dahr.			*
b. .?ad.dah.ri.	*!	*	

Since the deletion of short vowel in the phrase-final position is obligatory in QA, candidate (31b), which retains its final vowel, cannot be the optimal candidate. Candidate (31a) is the optimal one. Candidate (31a), with the composition of closed syllables only, satisfies *Phrase-final short vowel but at the expense of violating *Complex Coda. The second syllable of the optimal candidate is of the fifth type of the syllable patterns of QA, with a consonant cluster in the coda position. This kind of syllable is allowed in a final position, as in this situation. Consequently, *Phrase-final short vowel must dominate *Complex Coda.

We saw that the deletion of the short vowel in the phrase-final position entails the violation of the *Complex Coda constraint, as in (31) above. This deletion and, consequently, violation is also rooted in the failure of the application of the process of 'tanween' that, otherwise, would protect the short vowel from deletion and, consequently, would protect *Complex Coda from violation. Another case where *Complex Coda is violated is illustrated in (32), this time in order to satisfy a new constraint, *Phrase-final "tanween".

(32) *Phrase-final "tanween" >> *Complex Coda from [...xalq-i-n]_φ

Candidates	Ons *Complex Ons	*Phrase-final "tanween"	*[v, -long] _φ	*Complex Coda
a. .xal.qin.		*!		
b. .xal.qi.			*!	
c. .xalq.				*

In (32) candidate *a* fails to be optimal because the process that makes the consonant *n* join to the end of the indefinite noun and, therefore, protects the short vowel from deletion, cannot apply at the end of the phrase. Candidate *b* also cannot be optimal because a short vowel is disallowed in a final position (not to mention the unacceptability of an unstressed short high vowel in an open syllable). Therefore, candidate *c* is the optimal one because of the satisfaction of the two undominated constraints, *Phrase-final "tanween" and *[v, -long]_φ.

To conclude this section, (33) summarizes the ranking relationships established in this paper for QA.

(33) Ranking relationships

- Ons >> Fill Ons Fill Nuc.
- *Complex Ons >> Fill and *C[^v+high]\$,
- *Phrase-final tanween and *[v, -long]_φ >> *Complex Coda >> *C[^v+high]\$,

From the interactions of the constraints among each other, we can state that the following constraints are undominated:

Ons, *Complex Ons, *Phrase-final tanween and *Phrase-final short vowel, *[v, -long]_φ.

In contrast, the following constraints can be dominated:

Fill, *Complex Coda, and *C[^v+high]\$,

The undominated constraints cannot be ranked with respect to one another because they never come into direct conflict, given that two of them are concerned

with the onset and the other is concerned with the long vowel, which cannot be an onset.

4. Conclusion

In this paper, I have discussed the consonant cluster in the syllable structure of QA and some relevant issues. Data from the Quran was analyzed in the perspective of OT. In section 3, I argue that the syllable pattern (CVCC) is not basic in QA; rather, it is selected by ranked constraints. I also argue against Prince and Smolensky, 1994, p. 26 on the interaction of the constraints Fill and Ons in Arabic. In addition, I present forms from the Quran showing violation for the constraint *C[\check{V} +high]\$, which is ranked high in many modern Arabic dialects. I showed in this section that the grammar concerned with the syllable structure of QA is made up of a number of undominated constraints; namely, Ons, *Complex Ons, *Phrase-final tanween and *Phrase-final short vowel. Moreover, there are other constraints that can be dominated, such as *Complex Coda and Fill.

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