Velar, Uvular and Pharyngeal Alternations in Hasawi Arabic: A Harmonic Serialism Optimality Theoretic Approach

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Abstract

This thesis investigates three phonological phenomena in Hasawi Arabic (HA), a dialect spoken in the Eastern province of Saudi Arabia. First, is the pharyngealisation, which is triggered by the pharyngealised coronal segments /tˤ, ðˤ, sˤ/. Second, is the uvularisation, which is triggered by the uvular segments /q, ɢ, χ, ʁ/. The acoustic cues of the emphasis spread are measured via PRAAT and are represented by the feature [RTR]. The third phenomenon is the uvular segment alternations /ʁ/ and /q/.

All three phonological phenomena are accounted for within a Harmonic Serialism Optimality Theoretic analysis (HS-OT). With its harmonic and gradual derivational steps, HS-OT, as the framework of the phonological analysis throughout the thesis, examining all the attested phenomena, demonstrates its capabilities of gracefully capturing such complicated phonological phenomena. A fixed ranking of the constraints is established and an interaction between the phonological processes is exhibited. These interacting phonological processes include: resyllabification, insertion, voice assimilation, Manner of articulation assimilation and emphasis spread.

The results of the study reveal a distinctive characteristics and pattern of HA. Although both the pharyngealised and the uvular segments exhibit an emphasis spread on neighbouring segments in different domains and directions, the uvular segments, however, have a long-distance and a heavier emphasis effect on the adjacent vowels than the pharyngealised segments in HA. Based on the minimal pairs and local items that invariably surface with /q/ in the dialect, I also argue for the inclusion of the segments / and / in the consonantal inventory of HA. The alternation of the uvular segments /ʁ/ and /q/ is actually a conditioned phonological alternation not a free variation phenomenon as assumed by the previous research where a pattern is found and presented in HA.

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Dedication

I am blessed to have an army of supporters. I dedicate this work to them

My parents: Aneesa and Ahmed

My journey companions: my husband Abdulaziz (RIP) and my kids: Aljuri and Mohammed

My sisters and brother

My beloved grandfather: Abdulaziz (RIP) your name is written here as promised

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List of Abbreviation

Acronym	Definition
HA	Hasawi Arabic
HS-OT	Harmonic Serialism Optimality theory
FG	Feature Geometry
CA	Classical Arabic
MSA	Modern Standard Arabic
QA	Qatari Arabic
KA	Kuwaiti Arabic
OT	Optimality Theory
IPA	International Phonetic Alphabet
JA	Jordanian Arabic
DA	Dubai Arabic
OA	Omani Arabic
StOT	Stochastic OT
SPE	Sound Pattern of English
GEN	Generator
EVAL	Evaluation
CON	Constraints
GA	Generalized Alignment
HA	Harmonic Parallelism
GLA	Gradual Learning Algorithm
RBP	rule-based phonology
OT-CC	OT with candidate chains
ES	Emphasis spread
RTR	Retracted Tongue Root
RTB	Retracted Tongue Back
C	Consonant
V	Vowel
UVT	upper vocal tract
LVT	lower vocal tract
MOA	Manner of articulation
POA	Place of articulation
GAd	Gulf Arabic ch 5!
SSP	Sonority Sequencing Principle
UR	Underlying representation

1 Chapter One: Introduction

1.1 Introduction

The aim of this thesis is to provide a phonological analysis of some phonological phenomena in Hasawi Arabic (Henceforth, HA), a dialect spoken in the city of Alahsa in the Eastern province of Saudi Arabia, within the framework of Optimality Theory using the derivational version the Harmonic Serialism Optimality theory (HS-OT) (Prince and Smolensky, 1993; McCarthy, 2000). The investigated phenomena in in this study are the emphasis spread triggered by the pharyngealised and uvular segments in HA and the uvular segment alternations /q/ and /ʁ/ in HA.

The huge body on the emphasis spread triggered by pharyngealised /tˤ, ðˤ, sˤ/, and the uvular segments /q, χ, ʁ, ɢ/ phenomena in the literature leads one to think that HA would have a similar pattern to other Arabic dialect or closely related to the pattern of the Gulf dialects of Arabic. However, the pattern that HA exhibits for pharyngealisation and uvularisation is unique which will be presented in chapter four.

The uvular segment alternations are assumed to be in free variation and not conditioned in the literature. Not one of the Gulf dialects of Arabic which exhibit this alternation seem to have a clear pattern of this alternation. Whereas the data from HA provide several environments that condition each alternation and as such the /q/→ [ʁ] and /ʁ/→ [q] in HA is not free variation. The details of this phenomenon will be discussed in chapter five.

1.2 The dialect under investigation: HA

The term Gulf dialects refers to the range of Arabic dialects spoken in the area of the Arabian Gulf countries, including Kuwait, The United Arab Emirates, Qatar, Bahrain, Oman, and the Eastern part of Saudi Arabia called ‘Alahsa’ (Johnstone, 1967; Mustafawi, 2006; Bellem, 2007; Habib, 2012; Aldaihani, 2014).

The Gulf dialects have been classified as members of the Eastern Arabian, which branches of the Northern Arabian dialects. Among the Gulf dialects, Qatari Arabic (QA), Kuwaiti Arabic (KA) and HA all share common characteristics including the affrication of /k/ to [ʧ] and the substitution of /q/ to [g]. Another characteristic that is shared by some Northern Arabian dialects is the lenition of /ʤ/ to [j] (Johnstone, 1967 p.1-2).

HA, however, is different from any other Saudi dialects while it shows similarity in some ways with other Gulf dialects of the Arabian Gulf countries (Lewis, 2009). In addition, a difference is observed in these Eastern Arabic dialects due to the time difference of the urbanization process that affected the speakers of those varieties of Arabic dialects (Johnstone, 1967; Mustafawi, 2006).

Essentially, HA retains features of the language not found any more in other Saudi dialects because of its history of inhabitants. The history of Alahsa goes back thousands of years in this particular area. Many inhabitants like Kanoomites, Jun, Hermites, Tasmis and Banu Abdulqais, have occupied the city. Historically, Alahsa has many names: [ʔalʤarʕa] Aljarᶜa, [haʤɪr] Hajer, Albahrain, Majān, Bādi Riyāsh, Atrᶜdān, [ʔaħasaʔ bani: saʕd] Ahsa' Bani Saᶜd. It got its last name as [ʔalħasa] Alhasa or [ʔalʔaħasa] Alahsa in the 10th century After Christ (Smeaton, 1973; Aljumah, 2008).

Furthermore, because of its exposure to other languages, HA has innovated in some unique way. HA has undergone the influence of other countries and languages. Most importantly the Ottomans *'the Turks'* who ruled the region for 600 years. Other countries and languages that affected HA due to trade business are India, Persia and the English (Smeaton, 1973).

Figure 1-1: The map of Saudi Arabia ("Saudi Network." n.d)

Figure 1-1 above is a map of Saudi Arabia showing Alahsa city is located in the Eastern Province of Saudi Arabia which is indicated by the bold black ink on the map. The map shows Saudi Arabia as well as the rest of the Gulf Countries and *the Arabian Peninsula*. Alahsa city and the Alahsa Governorate with its scattered villages occupy almost 24% of the area of Saudi Arabia and 67% of the Eastern region as shown in map (1) above (Smeaton, 1973; Aljumah, 2008). The Eastern Province of Saudi Arabia as a whole has a population of about 4,900,000 as stated in the latest population census according to General Authority of Statistics[1]

Looking at the rich history of Alahsa and the large space it occupies in Saudi Arabia, it is remarkable that very little is known and reported about its dialect. This thesis therefore contributes to the system-

[1]K.o.S.A. *The Total Population*. 2019; Available from: https://www.stats.gov.sa/en/indicators/1

atic investigation of the dialect, focusing on some particularly interesting features of its consonantal phonology that are distinguished from other Arabic dialects, i.e. pharyngealisation/ emphasis spread triggered by the pharyngealised segments /tˤ, ðˤ, sˤ/, and the uvular segments /q, χ, ʁ, ɢ/ and the alternation of uvular segments in HA.

1.3 Participants in the study

The researcher is a native speaker of the investigated dialect, i.e. HA. In addition, there are 50 participants as representative sample of HA dialect. They are 25 female speakers and 25 male speakers. The selection of the participants is based on their linguistics background. The participants are native speakers of the investigated dialect HA and aged between 20-35. Moreover, the participants have never lived in a foreign language speaking country for a long period of time in order to limit the influence of the native speakers of that foreign language over the participants' production of the tested phenomena. A total number of three interviews were conducted with each participant.

1.4 Source of Data

This study is also unique in the way data are collected. Unlike some of the previous studies, there is no interference from my part where I do no manipulation or indication of what is supposed or expected to be said by the participants. That is maintained by collecting the data in a naturalistic style and drawn from recorded narratives of the speakers' personal experiences or interactions with other speakers, while the data in some of the previous studies were from some already prepared lists of words. An additional list of situations was provided to the participants in different sets of interviews where specific words were elicited from the given situations. This was done in order to address the phenomena under investigation properly. Due to cultural restrictions, being a female, the researcher could not attend the interviews in which the attendees were only male participants. As a result, the recordings of the male participants were

collected with the help of the researcher's brother. In addition, the data is complemented by extra forms from social media, namely snapchat application, from which I added some elicited lexical forms to my list of words by following users of the application in their daily routines for a short period of time. The users I followed are all native speakers of HA dialect and they are made aware of the research goals and their approvals have been obtained beforehand. It is true that my main intention is not to interfere with the participants. However, I needed to elicit more words in order to complete the analysis.

The audio recordings are conducted using a digital recording device and PRAAT the speech analysis software' installed on MacBook Pro laptop while the data is supposed to be in the naturalistic style following the style of Labov (1997). In addition, the participants produced the investigated segments in naturally as explained in Kerlinger (1973) and reported in Recasens and Espinosa (2005) that is, as I mentioned earlier, without any influence or manipulation from my part as much as possible. The data obtained consisted of 2500 words. The words with the pharyngealised and the uvular segments represent the pharyngealisation/ uvularisation phenomenon, i.e. emphasis spread which is exemplified by 1370 words, while the /q/ and /ʁ/ alternation phenomenon in HA is exemplified by 1130 words. Whereas 90 words show no change.

The data collected through the audio recordings are then transcribed by the researcher using the International Phonetic Alphabet (IPA) symbols and analyzed phonologically. Some words were analyzed phonetically using PRAAT in order to measure the effect of the pharyngealised and the uvular segments on the F_2 of the adjacent vowels.

1.5 Literature Review

Linguistic interest in Alahsa first began when oil was discovered in the area in 1934 and the American-Saudi oil company 'Aramco' started digging for oil. Smeaton (1973) described the area and the people of

Alahsa after the oil discovery. He was one of the linguists who were sent to the area as English teachers to teach the Saudi employees recruited by the company. Some phonological phenomena of HA have been mentioned by Johnston (1967). Smeaton (1973), on the other hand, is one of the first studies to offer a linguistic account of HA. The data of the study was collected between 1945 and 1949, and the book was released in 1973. At that time, the Saudi people in that area knew no English. The foreign English teachers had to learn Arabic, more specifically, the local dialect HA '*Hasawi'*, in order to be able to communicate and teach Hasawians English. Smeaton (1973) provides a general description of HA. He discusses the sounds, 'consonants and vowels', some phonological phenomena, and the syntax. He does not, however, dwell on the phonological alternation that I will be concerned with. The main focus of his study is a historical review of the area and an account of the variety of lexicon in the dialect.

Later, Prochazka (1988) provides description and analysis of several Saudi Arabian dialects including the dialect of 'Alahs- Hofuf', i.e. HA dialect. The focus of his research focuses mainly on the verb conjugations and suffixes and related morphological data (Prochazka, 1988 p.9). He also provides a brief introduction to the phonology of the dialects he studies with segmental inventories, an account of segmental variations including the alternation of the /q/ and /ʁ/, 'consonants and vowels', the syllables, stress assignment and he points out the differences in the dialects under study. In addition, he briefly illustrates various phonological phenomena with examples. However, no systematic explanation was given for the uvular alternation.

More recently, other studies have mentioned HA with some examples and significant consonantal phenomena such as Feghali (2004) and Feghali (2008) provide texts collected from several Saudi dialects and other Gulf dialects respectively. HA is an under studied dialect within the framework of OT. There are, however, two studies that the studies that have analyzed the HA within the OT framework are scarce: Aljumah, (2008) and Al Sadhaan (2015) both investigate HA within the Classical OT framework. On one

hand, Aljumah, (2008) investigates the syllable shape and structure in HA. On the other hand, Al Sadhaan (2015) investigates the prosodic structure and stress assignment in HA. Very recent work on HA include who investigates sociolinguistic variation and change in the dialect of Alahsa from a sectarian aspect. However, Aljumah, (2008) and Al Sadhaan (2015) studies are relevant to the present study in their use of OT, which I will also adopt, but not the same Classical version of OT and not in the actual phonological issues that they have dealt with in their research. It is also relevant to the present study in its discussion of consonant clusters and their position within the word, which will prove to be an important factor in the consonantal alternation, that I am concerned with. Nonetheless, to the best of my knowledge no studies on HA have investigated the pharyngealisation, uvularisation and uvular alternation in HA from a HS-OT perspective.

One of the distinctive features of the phonology of most dialects of Arabic is the presence of a range of what are traditionally called ‘emphatic' consonants, and a set of uvular consonants. The former is described in phonetic terminology as being pharyngealised, within Arabic an added element of velarisation or uvularisation, depending on the dialect (Thelwall, 2003). The latter are sounds articulated further back in the throat than velar sounds that are familiar in languages such as English. These form the focus of attention of the present study because of their significant behaviour in HA where both the pharyngealised segments /tˁ, ðˁ, sˁ/ and the uvular segments /q, χ, ʁ, ɢ/ have a similar emphasis spread effect on adjacent segments that could cover an entire word on the lexical, morphological and post lexical levels. The other focus of the study is concerned with the alternation of the uvular segments /ʁ/ and /q/ in HA. A phenomenon assumed to be in free variation in the literature where no pattern is found in the dialects that exhibit this type of alternation such as QA and KA and other Gulf dialects (Mustafawi, 2006; Aldaihani, 2014; and Hussain, 1985).

Although there is a huge body in the literature on emphatics and their strong connection to uvular segments, to the best of my knowledge, no study has been done comparing the effect of pharyngealised segments to that of uvular segments in HA, or exploring the alternation of the uvular segments within the HS-OT segments in a dialect of Arabic.

The earliest mention of the sounds under investigation is in the classification of HA consonants is that reported in Johnstone (1967), confirmed later by Smeaton (1973) and Habib (2012). As I noted above, Smeaton (1973) was the first to look at the HA as a distinct variety among different Eastern Saudi dialects. However, his study of HA was lexical and did not really focus on the phonetic or the phonological aspects of the dialect. Other studies that have been mentioned in the previous section also did not address the phenomena under investigation in this study properly. Literature relevant to the phonological phenomena under investigation and concerned with HA will be reviewed in following chapters accordingly.

1.6 Significance of the study

This research is significant since to the best of my knowledge, it is the first research to investigate the phenomena of pharyngealisation in HA from a HS-OT perspective. It is also the first research to investigate the alternation of the uvular segments /q/ and /ʁ/ in HA within the framework of HS-OT. The strong finding that unlike the previous studies, based on the data in this research, the alternation of /q/ and /ʁ/ is not a free variation, but conditioned by different factors such as pharyngealisation environment, positional factors and consonant clusters. The present research will therefore contribute accurate data and fill a gap in the literature about selected phonological phenomena in the HA dialect. Comparisons will be drawn with related Arabic dialects, especially the Gulf dialects, and other languages relevant to the investigated segments.

1.7 Notation conventions

I adopted the IPA symbols to exhibit the transcription of the data given in this study. Input representations are identified by slants '/ /', while output representations are labelled with '[ ]' square brackets. For indicating a long variant of a vowel, the length mark presented by the IPA symbol (ː). I have used the dot '.' to denote syllable boundaries. The '→' arrow is translated as 'modified into' while the section symbol '§' reflects a part of the thesis. Finally, incorrect forms are marked by an asterisk (*).

1.8 Overview of the study

The rest of the thesis is laid out in five chapters. Chapter two demonstrates some aspects of the phonology of HA dialect. It presents an overview of the segmental inventory in terms of consonants and vowels, a brief discussion of the segments under study, the syllable structure and basic stress assignments in HA.

Chapter three provides background information on the phonetics and acoustic correlates of emphasis. It also presents a Feature Geometry adopted in this study and the feature that represents the emphasis in HA which is [RTR]. The chapter also offers a theoretical background in regard to the Optimality Theory (OT) approach and HS-OT. It also presents a justification of preferring the derivational HS-OT to parallel OT in the analysis of the current study.

Chapter four is concerned with the emphasis triggered by the pharyngealised and uvular segments in HA. It provides a discussion of the classification of emphatic and guttural sounds in HA, the domain of emphasis, direction of emphasis, blockers of emphasis and comparison with other dialects of Arabic is drawn where suitable, PRAAT, is used to provide a phonetic analysis of the effect and correlates of pharyngealised sounds in HA and a phonological analysis of pharyngealisation and uvularisation within the HS-OT perspective is also presented. The literature review of the phenomena is presented where suitable.

Chapter five reports on the phenomenon of alternation in the uvular segments /q/ and /ʁ/ in HA.

The literature review of the phenomenon is presented where suitable and several cases of the uvular segment alternations in HA are presented and illustrated with a phonological analysis within the HS-OT perspective. Consequently, an alternation pattern is recognized from the data in HA.

Chapter six provides a summary of the phenomena covered in the thesis and the main findings of the thesis. The contribution of the current study along with recommendations for future research and advantages and disadvantages of adopting HS-OT framework in this study are also presented in this chapter.

1.9 Conclusion

In this chapter I have presented an introduction to the thesis. I have provided a brief historical background of the area and the dialect under investigation. HA dialect has been explored in a brief historical review. Relevant literature review about the dialect, details about the source of data, the data collection procedure and the participants, are provided. The significance and the contribution of the study have been presented. Finally, I have laid out the overview of the thesis along with the notational conventions used in this study.

2 Chapter Two: Some aspects of the phonology of HA

2.1 Introduction

The purpose of this chapter is to investigate some aspects of the HA phonological system. It begins with a brief overview of the region and when linguistic interest in the area first arose. Some of the studies devoted to the HA and the studies that listed some of the dialect's observed phenomena are reported. It incorporates the dialect's segmental inventory: consonants and vowels. It presents the debate surrounding the alternation of the uvular segments /q/ and /ɢ/ and the velar segment /g/ in HA. In addition, this chapter includes an introduction to the structure of the syllable, assignment of stress and patterns in HA. In brief, a description of the dialect under investigation is given in this chapter.

2.2 The segmental inventory of HA

The list of segments, i.e. consonants and vowels, that should be included in HA segmental inventory is a source of debate among the researchers of HA. Regardless of their disagreements, I provide the consonantal and vowel inventories of HA as follows, based on the elicited data from the current study.

2.2.1 Consonantal inventory of HA

Table 2-1 below demonstrates the full consonantal inventory of HA in IPA symbols. The consonants are categorised according to their place of articulation, manner of articulation and voice. The consonants to the left side of the cell are voiceless, while the ones to the right side of the cell are voiced. The emphatic consonants are represented with the articulatory superscript symbol /ˤ/, which is placed after the consonant to indicate a pharyngealised one.

Table 2-1: The consonantal inventory of HA

Manner of Articulation		**Place of Articulation**									
		Labials	Coronals					Dorsals			
		Bilabial	Labio-dental	Inter-dental	Alveolar	Palate-alveolar	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop		b			t d			k g[2]	q ɢ[3]		ʔ
Emphatic stop					tˤ						
Nasal		m			n						
Fricative			f	θ ð	s z	ʃ			χ ʁ	ħ ʕ	h
Emphatic fricative				ðˤ	sˤ						
Affricate						ʧ ʤ					
Liquids	Trill				r						
	Lateral				l						
Approximants		w					j				

Table 2-1 shows 30 consonants in HA dialect. There are eight stops /b, t, d, k, g, q, ɢ, ʔ/, three primary emphatics/ pharyngealised consonants /tˤ, ðˤ, sˤ/, two nasals /m, n/, 11 fricatives /f, θ, ð, s, z, ʃ, χ, ʁ, ħ, ʕ, h/, two affricates /ʧ, ʤ/, the lateral /l/, the trill /r/ and two approximants /w, j/[4]. The segment /ɢ/ has a phonemic status in HA where it surfaces in some examples in the dialect invariably with no cognates

[2] The voiceless uvular stop /q/ and the voiced velar stop /g/ are both phonemic in HA. Their phonemic status will be discussed in chapter four and chapter five.

[3] The voiced uvular stop /ɢ/ is phonemic in HA. In some cases, /ɢ/ appears as an allophonic of /q/ as a result of an assimilation process and /ɢ/ will also appears as an allophonic of /g/ as a result of pharyngealisation process. This will be introduced in chapter five.

[4] It is worth mentioning that emphatic variants of /r/ and /l/, i.e. /rˤ/and /lˤ/ are present in HA in certain environments especially where back vowels are involved (Bukshaisha, 1985).

in the MSA. Both /q/ and /g/ are separate phonemes in HA since their occurrence is eminent in the dialect with HA examples presented in the study. I incorporated the voiceless uvular stop /q/ into the inventory since it is still an active phoneme in HA and does not exclusively occur in religious words as assumed by Hussain (1985). I also included the velar segment /g/ and the affricate segment /ʧ/ in the phonemic inventory of HA. On one hand, /g/ is conventionally presumed to be the surface form from the underlying voiceless uvular stop /q/ (Smeaton 1973; Prochazka, 1988; Mstafawi, 2006). On the other hand, /ʧ/ is thought to be the surface form from the underlying voiceless velar stop /k/ in some modern varieties of Arabic (Moscati, 1969, p. 38), Iraqi and the Bedouin Levantine dialects (Cantineau, 1936, 1937) and in Kuwaiti, Bahraini, Qatari, and the UAE (Johnstone, 1967, 1978; Maṭar, 1985; Al-amadidhi, 1985).

Although the HA mentioned scarcely in the literature, the phonological system of HA has not been not investigated thoroughly. Smeaton (1973) claims that the consonantal inventory of HA includes 29 consonants excluding both /dˤ/ and /ʒ/. Whereas Aljumah (2008) presents a consonantal inventory of HA which is a reflection of the Modern Standard Arabic (MSA) with 31 consonants including the emphatic alveolar stop /dˤ/. The alveolar voiced stop /dˤ/ is completely replaced in the Gulf dialects of Arabic by the emphatic inter-dental fricative /ðˤ/ where /dˤ/ is lost, but /ðˤ/ is preserved (Hussain, 1985; Al-Wer 2004). Aljumah (2008) also claims that HA exhibits the affricate sound /ʧ/, which only, in his opinion, appears in loan words not in Arabic ones.

However, with the existence of some lexical items, the collected data for this thesis, in HA and a variety of the Gulf dialects and other dialects of Arabic, in which /ʧ/ occurs invariably with /k/ and /g/ occurs invariably with /q/, then I consider /ʧ/ and /g/ as distinctive phonemes in HA[5]. They are also considered variants of /k/ and /q/ respectively in other cases where there are local items that exhibit this

[5] However, the cases of affrication of /k/ to [ʧ] are beyond the scope of this study and are left for further research.

variation (Johnstone, 1967, 1978; Altoma, 1969; Bukshaisha, 1985; Maṭar, 1985, p. 147; Hussain, 1985; Al-Sulaiti, 1993; Mstafawi, 2006).

2.2.2 Vowels inventory in HA

Table 2-2 below demonstrates the vowel inventory of HA in IPA symbols. The vowels are categorised according to the hight and backness of the tongue during articulation. The emphatic alternative of the high vowels /i, u/ are represented with a bar /-/, which is placed in the middle of the vowels /i/→ [i̠] and /u/→ [u̠] to indicate pharyngealised allophones (Evans, 2015).

Table 2-2: The vowel inventory in HA

Height	**Backness**					
	Front vowels		Central vowels		Back vowels	
	Short	Long	Short	Long	Short	Long
High	i i̠	iː i̠ː			u u̠	uː u̠ː
Mid			e	eː	o	oː
Low			a	aː	ɑ	ɑː

It is clear from Table 2-2 above there are 16 vowels in HA. All of the vowels in HA, thus, have a short and a long form. The back vowels which represent the pharyngealised environment are added to the inventory according to the classification of Al-Ani (1970), i.e. /ɑ(ː)/, /u̠(ː)/ and /i̠(ː)/. What is shown here is a phonetic vowel inventory of HA which shows the allophonic lowered or back vowels in a pharyngealisation and a uvularisation environment /i/→ [i̠], /u/→ [u̠] and /a/→ [ɑ]. This study focuses on these three /i, u, a/ vowels and their allophonic lowered ones /i̠, u̠, ɑ/. The phonetic transcription of the vowels is important to illustrate later on the emphasis spread triggered by the adjacency to the pharyngealised and

the uvular consonants in HA. However, additional vowels are added to the inventory for the sake of reporting and because they surfaced through the data collection. These vowels are: /eː/ and /oː/. Smeaton (1973) denotes the emergence of new vowels in HA like /e/ and /o/ and he reasons this emergence to the contact the speakers of HA have had with other languages such as English. Whereas Aljumah (2008) notes that HA is famous for being a long vowel dialect.

2.3 Consonants under study in HA

This section focuses on the consonants under investigation in this study that have caused some discrepancies in the literature. Most importantly, the uvular /q/ and the velar /g/. There is consensus amongst Arabs as well as some linguists that Classical Arabic or "*al-fusʕħa"*[6] is the original source to the modern varieties of Arabic dialects. It is the language of the Quran, and as such it is considered as the purest variety of Arabic to which all other varieties should adhere (Altoma, 1969, p. 5).

The consonantal inventory of Classical Arabic/ MSA consists of 28 consonants. However, some colloquial varieties of Arabic include two additional consonants such as /g/ and /ʧ/. For a segment like /g/, in order to decide on its underlying representation, it must have a cognate in "*al-fusʕħa".* Although unconditional substitution of /q/ by [g] in other Gulf dialects of Arabic for 12 centuries is reported in the literature (Johnstone, 1967), some linguists, however, still consider /q/ as the "*al-fusʕħa"* cognate for [g]. The same goes for /g/ in the analysis for HA according to Aljumah (2008). Traditionally, another way to determine the underlying representation of a surface form is suggested to be through its orthographical representation, which basically means the same thing as cognate in "*al-fusʕħa"* (Al-amadihi, 1985) and (Maṭar,1984) respectively.

[6] "*al-fusʕħa"* refers to both Classical Arabic as well as MSA.

Considering /q/ as the underlying representation for the surface forms of HA dialect with [g] traditionally do not put into account the forms that occur in HA invariably with /g/ as in examples (2-1). Nor does it account for the lexical items in HA that include /g/ or /ɑ/ and consider /q/ as its' Classical Arabic/ MSA cognates, which exhibit a semantic shift as in examples (2-2). Whereas the example in (2-3) are of local forms in HA that occur invariably with /q/.

Just like other varieties of Arabic, such as Qatari Arabic Mustafawi (2006), words in HA, which exhibit the occurrence of /g/ have cognates in MSA but with /q/. Although they appear similar, their meanings have semantically shifted. Take a look at the examples:

Example 2-1 /q/ vs. /g/ in CA vs. HA

	Example	**Gloss**
(1)	a. [qɑʃ] b. [gaʃ]	'straw' 'Personal belongings'
(2)	a. [haqɑ] b. /haga]	'longed to' 'thought to'
(3)	a. [ʔqʃar] b. [ʔaqʃar]	'red-skinned' 'aggressive'

The examples in (1a), (2a) and (3a) are obtained from Ibn Manẓūr (1967 version) CA dictionary originally written between 1232 and 1311 A.D. While the examples in (1b), (2b) and (3b) are from my collected data on HA. It is worth mentioning that the open vowel adjacent to /q/ is broadly transcribed as /a/ in the literature. However, the open vowel adjacent to /q/ in this study is always transcribed as /ɑ/ the back variable of /a/ that appears adjacent to /g/. In my opinion, it is not sufficient after having the segmental change and the semantic difference to consider the segment /q/ as the underlying representation of [g].

The following examples occur in HA and other Gulf dialects of Arabic, such as QA and KA, with /ɡ/ and /ɢ/ invariably and have no cognates in CA and MSA:

Example 2-2 /ɡ/ and /ɢ/ in HA

Example	**Gloss**
[ɡarɡar]	'chatter'
[sˤɑrˤɢɑʕ]	'reckless'
[ʃaŋgaħ]	'flip'

The following examples occur in HA with /q/ invariably. These examples in (2-3) of /q/ along with those in (2-1) of /ɡ/ prove the phonemic status of both the voiceless uvular stop /q/ and the voiced velar stop /ɡ/ in HA.

Example 2-3 /q/ in HA

Example	**Gloss**
[qɨːfa]	'ugly'
[qɑnʧa]	'serving dish'
[qʉħ]	'original'
[qɑθˤrˤɑh]	'a mess'

As illustrated in the examples in (2-3) above, /q/ is associated with back or lowered vowels, i.e. /ɨ/, /ʉ/, /ɑ/. The phonetic correlates for /q/ are reported in several studies in the literature. Al-Ani (1978, p. 32-33) reports a lowering and backing effect to the values of F_2 of the vowels adjacent to /q/ see also (Ghazeli, 1977). The assumption that /q/ could undergo affrication is an argument for the impossibility for the /q/ affrication triggering by adjacency to front vowel since /q/ never surfaces adjacent to front vowels /a(ː), i(ː)/ in MSA. The uvular /q/ has a lowering and backing effect on adjacent /i, iː/ → [ɨ, ɨː]. It does not,

however, change the fact that the vowel is a front vowel. Therefore, the affrication process begins to apply. First, the variation from /q/→ [g] could be an assimilation process in the sense that /q/ is fronted adjacent to front vowels from a uvular /q/ to a velar /k/. Then, a lenition process progresses in the sense that the feature [-voice] /k/ becomes [+voice] [g]. However, this theory does not explain the existence of /q/ and /g/ minimal pairs invariably in HA.

The underlying form of the data used in this study is derived from the dialect itself where it appeared sometimes during the recording synchronically. The MSA is therefore not considered the underlying representation in this study. The phonemic status of /ʁ/ in HA as well as other Gulf dialects is well established. Whereas the phonemic status of /q/ is debatable some argue that /q/ surfaces only in religious contexts (Alamadihi, 1985; Hussain, 1985). Others argue that it has been substituted by /g/ (Johnstone, 1967; Alamadihi, 1985; Hussain, 1985; Mustafawi, 2006; Aldaihani, 2014). The data collected in this study suggest otherwise. Lexical items in HA which occur invariably with /q/ as well as /g/ is a strong evidence of the phonemic status of /q/ and /g/ is HA.

The voiced uvular stop /ɢ/ also alternates with voiceless uvular stop /q/ in some cases in HA. The status of /ɢ/ in HA is controversial be it allophonic or phonemic. More about the status of the voiced uvular stop /ɢ/ is discussed in chapter four and five. In general, the velar /g/ surfaces in the vicinity of front vowels /a/ and /i/ and it alternates with the uvular /ɢ/ which surfaces in the vicinity of back vowels / pharyngealised vowels /ɑ/, /ʉ/ and /ɨ/.

The examples in (2-4) below exhibit the phonemic status of /q/and /g/ in HA where they are almost minimal pairs. The examples in (2-4) illustrate that in some cases, /q/ and /g/ occur contrastively as distinctive phonemes in HA. It is worth noting that the vowels in the vicinity of the uvular /q/ are of back quality /ɑ/, /ʉ/ and /ɨ/ whereas in the vicinity of the velar /g/ the vowels are of front quality /a/ and /i/.

Example 2-4 phonemic status of /q/ and /g/ in HA

(a)	Input	Output	Gloss
	/rawɑːq/	[rawɑːq]	‘gallery’
	/rawaːg/	[rawaːg]	‘chill’
	/qɨr/	[qɨr]	‘confess’
	/qɑʃ/	[qɑʃ]	‘straw’
	/gaʃ/	[gaʃ]	‘luggage’
	/qɑlb/	[qɑlb]	‘pendant’
	/qɑsˁɨrˁ/	[qɑsˁɨrˁ]	‘shorten’

While the examples in (2-5) exhibit the allophonic status [ɢ] which is the surface form of /q/ and /g/ as a result of voice assimilation and pharyngealisation processes respectively in HA. More about the classification of the guttural class in HA, the pharyngealised and the uvular segments is discussed in chapter four. Whereas the phenomena of the uvular segment alternation and the substitution of /q/ → [g] and /q/→ [ɢ] will be discussed in details in chapter five.

Example 2-5 allophonic status of [ɢ] in HA

(b)	Input	Output	Gloss
	/ʔɑqbˁɑʕ/	[ʔɑɢbˁɑʕ]	‘escape’
	/bʉqʕah/	[bʉɢʕah]	‘a stain’
	/gɨr/	[ɢɨrˁi]	‘settle’
	/gaʃ/	[gaʃ]	‘luggage’
	/gɑlb/	[ɢɑlˠbˠ]	‘heart’
	/gɑsˁɨr/	[ɢɑsˁɨrˁ]	‘palace’

2.4 Syllable structure of HA

This section is dedicated to presenting a description of the syllable structure types and patterns in HA. Possible syllable patterns are illustrated in Table 2-3 below with monosyllabic, disyllabic and poly-syllabic words. The syllables could be light, heavy or superheavy. The light syllable is assigned one mora, i.e. monomoraic the syllable is an open one with an empty coda or the light syllable is a closed one with a consonant in a final position. Whereas the heavy syllable is bymoraic when there are two vowels in the nucleus of the syllable or the syllable is a closed one with a consonant in a non-final position. By contrast, the superheavy syllable is bymoraic when there are two vowels in the nucleus of a closed syllable or the syllable is a closed one with one vowel and a consonant cluster in the coda. Other syllable patterns appear in HA as a result of other phonological process such as deletion and metathesis.

Table 2-3: HA syllable patterns

Types of syllables	**Syllable pattern**	**HA words**	**Gloss**
Light	CV	ʔa.na	'I'
	CCV	gha.wa	'coffee'
	CVC	[bɑtˁ] [ka.bat]	'ducks' 'closeth'
Heavy	CVV	[raɪ] [ʔiː]	'opinion' 'yes'
	CCVV	[swaː.ra(h)]	'a bracelet'
	CVC	[kaʃ.ta(h)]	'camping'
	CCVC	[ʧbab.aːt]	'meatballs'
Superheavy	CVVC	[fuːt] [ħuːt]	'wasp' 'whale'
	CVCC	[biʃt]	'coat'
	CCVVC	[sˁmˁɑːtˁ]	'table cover'
	CCVCC	[tʕalʧ]	'chew'

The table above exhibits the possible syllable patterns in HA. There are ten possible syllable patterns in HA. These patterns are illustrated by monosyllabic, disyllabic and polysyllabic words. The symbol (.) marks the boundaries of syllables. Looking at the table above, it is clear that the smallest syllable unit in HA is CV. No syllable starts with a vowel, which means, just like all other dialects of Arabic, it is obligatory for syllables to have onsets is in HA. The rhyme of a syllable must include, at least, a vowel in the nucleus. The nucleus could be filled with a short vowel, a long vowel or a diphthong. The coda, however, is optional in HA, which means it could be left empty as in (CV, CCV, CVV, CCVV) patterns. In this case the syllable with an empty coda is an open one. While when the coda is filled with a consonant, then the syllable is a closed one as in (CVC, CCVC, CVVC, CVCC, CCVVC, CCVCC). From the aforementioned syllable patterns, it is obvious that both the onset and the coda of a syllable can be simple containing one consonant each or they can be complex containing consonant clusters.

The table presents three main types of syllable patterns, i.e. light syllable monomoraic, heavy syllable bimoraic and superheavy syllable bimoraic due to extrametricality (Hayes 1989; McCarthy & Prince 1990). These syllable patterns are as follows: Light syllable: CV, CCV and CVC when it is in a word-final position. Heavy syllable patterns include CVV, CCVV, CCVC and CVC is in a non-final position, it is considered a heavy syllable pattern. The CVVC, CVCC, CCVVC and CCVCC are the superheavy syllable patterns in HA[7].

Although the CV and CCV are light syllable patterns, they do not occur in monosyllabic words in HA except for some function words like [ða] ‘this’, [ði] ‘this’, [tˁɑ] ‘ok’, [li] ‘for me’, [hu] ‘he’, [hi] ‘she’, [wu] ‘and’ and [ju] ‘interjection’ [ʔiː] ‘yes’, [la] ‘no’. In addition to the CV functional forms, some content

[7] In a CVC syllable, when in a coda position and a word-final, the glottal stop /ʔ/ and the fricative /h/ are usually deleted in HA. As a result, a CVC syllable becomes CV.

words of the CV form are found in HA dialect, such as [ʤa] ‘he came’ and [fi] ‘there is’[8]. Other studies, however, indicate that the Arabic word has a minimum bimoraic size. This is expressed by the constraint of word-minimality (McCarthy & Prince 1990, 1993, 2004; Al-Ageli, 1995). Since CV is a monomoraic syllable, then it is banned in monosyllabic words in all dialects of Arabic according to some researchers to mentions a few (Abu-Mansour, 1990; Broselow, 1992; Farwaneh, 1995; Watson, 2002).

Heavy syllable patterns in HA are CVV, CCVV, CCVC and CVC is in a non-final position. These syllable patterns are bimoraic. In each of CVV and CCVV syllable patterns, the nucleus is occupied with a long vowel, so it assigned two moras. While in non-final CVC syllable, the nucleus is assigned a mora since it is occupied with a short vowel and so does the coda. The same will apply on the CCVC pattern, the in non-final position, the short vowel in the nucleus is assigned a mora and the coda consonant is assigned a mora (McCarthy, 1980; Angoujard, 1990; McCarthy & Prince 1990). However, in a final position CCVC the coda is not assigned a mora due to extrametricallity of a domain rightmost consonant (Hayes, 1995 p. 57; Watson, 2011).

The superheavy syllable patterns in HA are CVVC, CVCC, CCVVC and CCVCC. These syllable patterns are also bimoraic since the consonant in the coda in a word-final position is subject to extrametricality. This means that the final coda does not receive a mora. In the coda cluster pattern, CVCC, the first consonant in the coda cluster receives a mora while the second one does not[9]. The data in this study agree with Aljumah (2008) indicating that HA allows coda consonant clusters.

Unlike the coda consonant cluster, which is found in CVCC syllable type in HA, the phenomenon

[8] Although in the surface [ʤa] ‘he came’ underwent a deletion process in which the coda was deleted and the long vowel is shortened an underlying CVVC form /ʤaːʔ/ where the V is. The same goes for the CVVC of /fiːh/ ‘there is’ where the /h/ in the coda was deleted and the long vowel is shortened /fiːh/ → [fi].

[9] Extrametricality of a coda consonant is represented by placing it within an angled brackets CV<C> (Liberman and Prince, 1977; Prince, 1983; Hayes, 1979, 1995).

of having onset consonant cluster types of syllables (CCV, CCVV, CCVC, CCVVC) is a result of a syncope process. It has been reported in other dialects of Arabic such as two Bedouin dialects of Jordanian Arabic (JA), i.e. Bani Hasan and 9abady Arabic (Sakarna, 1999 and Irsheid, 1984) respectively and in Kwaiti Arabic (KA) (Aldaihani 2014). The same phenomenon is noticed in other Arabic dialects when compared to Classic Arabic such as Qatari Arabic (QA) (Al-Sulaiti, 1993), Dubai Arabic (DA) (Hoffiz, 1995), Omani Arabic (OA) (Shaaban, 1977), and Morocan Arabic spoken in Casablanca (Boudlal, 2001).

Table 2-4: Onset consonant clusters in HA

Syllable types	**CA**		**HA**	**Gloss**
CCV	/ba.qa.rah/ CV.CV.CVC	→	[bga.rah] CCV.CVC	'cow'
CCVV	/si.waː.rah/ CV.CVV.CVC	→	[swaː.rah] CCVV.CVC	'bracelet'
CCVC	/θa.ma.ra.tah/ CV.CV.CV.CVC	→	[θmˁɑrˁ.tah] CCVC.CVC	'his fruit'
CCVVC	/ħi.maːr/ CV.CVVC	→	[ħmˁɑːrˁ] CCVVC	'donkey'
CCVCC	/taʕ.luk/ CVC.CVC	→	[tʕalʧ] CCVCC	'she chews'

Table 2-4 above illustrates the types of syllable occurring in HA by comparing the syllable patterns to those of CA using the same words. The CA examples show that onset consonant clusters are not allowed in CA (Abu-Salim, 1982). On the contrary, when the same examples produced in HA, they surface with onset consonant clusters. The CA disyllabic, trisyllabic and tetra-syllabic words are truncated into monosyllabic and disyllabic words respectively producing onset consonant clusters in HA. This indicates a deletion or metathesis process is in operation in HA.

The table also shows which syllable the deletion process in the given examples affects. In the disyllabic word /ħi.maːr/ /CV.CVVC/ is truncated into the monosyllabic word [ħmˤɑːrˤ] [CCVVC] by omitting the vowel of the initial / penultimate open syllable and the remaining content of that syllable, the onset consonant, is merged with the other syllable. In the trisyllabic words, the vowel of the antepenultimate open syllable is omitted causing the stand alone consonant to merge with the following syllable forming disyllabic words as in /ba.qa.rah/ /CV.CV.CVC/ to [bga.rah] [CCV.CVC] and /si.waː.rah/ /CV.CVV.CVC/ to [swaː.rah][CCVV.CVC]. As for the tetra syllabic word /θa.ma.ra.tah/ /CV.CV.CV.CVC/, two vowels are deleted. On one hand, the vowel of the preantepenultimate syllable is omitted and the consonant merges with following syllable. On the other hand, the vowel of the penultimate syllable is omitted and the consonant merges with preceding syllable. The deletion of tow vowels transforms the word from a tetra syllabic word into a disyllabic word [θmˤɑrˤ.tah] [CCVC.CVC].

However, the deletion process in the tetra syllabic word /θa.ma.ra.tah/ in the table above is applied in a morphological level. The word without any morphemes is actually a trisyllabic word /θa.ma.rah/ /CV.CV.CVC/, which becomes a disyllabic [θmˤɑ. rˤɑh] [CCV.CVC]. More examples of the same pattern are illustrated in Table 2-5 below:

Table 2-5: /CV.CV.CVC/ → [CCV.CVC] in HA

CA CV.CV.CVC	**HA words CCV.CVC**	**Gloss**
/ba.qa.rah/	[bga.rah]	‘cow’
/ʃa.ʤa.rah/	[ʃʤa.rah]	‘tree’
/wa.ra.qah/	[wri.gah]	‘paper’
/da.ra.ʤah/	[dri.ʤah]	‘stair’
/ʕa.ta.bah/	[ʕti.bah]	‘threshold’

Other interesting examples are the disyllabic words that change from CVC.CVC pattern with simple onset into a consonant onset cluster CCV.CVC pattern. This indicates that HA prefers initial open syllable pattern. Contrary to what Aljumah (2008) assumes in his paper in which he reckons that HA does not allow onset consonant clusters. The examples below contradict Aljumah's result and act as an additional proof that HA does allow onset consonant clusters. This pattern indicates that a metathesis process is in operation in HA in which a consonant moves from its coda position into the onset position forming an onset consonant cluster without deleting the vowel in the affected syllable. More examples of the same pattern are illustrated in Table 2-6 below:

Table 2-6: Metathesis in HA

CA CVC.CVC	**HA words CCV.CVC**	**Gloss**
/qah.wah/	[gha.wah]	'coffee'
/ʃaʕ.rah/	[ʃʕa.rah]	'a single hair'
/naχ.lah/	[nˁχɑ.lˁɑh]	'palm tree'
/ʃah.wah/	[ʃha.wah]	'desire'
/sˁɑχ.lˁɑh/	[sˁχɑ.lˁɑh]	'sheep'

Not only does HA show this phenomenon of preferring the initial open syllable pattern, in which the coda consonant moves from the coda position into the onset position as the second consonant in the onset consonant cluster, but it has been reported in other dialects of the Gulf Arabic dialects such as KA, DA, and QA (Aldaihani, 2014; Hoffiz, 1995; Al-Sulaiti, 1993) respectively.

Table 2-7 below provides an overview of four Gulf dialects discussed in this chapter in terms of five syllable types with examples. DA dialect does not allow complex onset syllables as reported by Hoffiz

(1995). However, during the observation of native speakers of DA dialect, they produced instances of syllables with a complex coda CCV.CVCC [θˤmˤɑrɑtk].

Table 2-7: Syllable types in GA dialects

Syllable types	CA Abu-Salim (1982)	KA Aldaihani (2014)	DA Hoffiz (1995)	QA Al-Sulaiti (1993)	HA This thesis
CCV	/θa.ma.rah/	[θmˤɑ.rˤɑh]	-	[θmˤɑ.rˤɑh]	[θmˤɑ.rˤɑh]
CCVV	/si.waː.rah/	[swaː.raː]	-	[swaː.raː]	[swaː.rah]
CCVC	/naχ.la.tu.hu/	[nχɑlˤ.taː]	-	[nχɑlˤ.taː]	[nχɑlˤ.tah]
CCVVC	/ħi.maːr/	[ħmˤɑːrˤ]	[ħmˤɑːrˤ]	[ħmˤɑːrˤ]	[ħmˤɑːrˤ]
CCVCC	/taʔ.luk/	*	*	*	[tʕalʧ]

2.5 Stress patterns in HA

HA stress patterns have been briefly presented in the literature by Al Sadhaan (2015). Another phonological study of the HA dialect is that by Aljumah (2008), in which he tackles the syllable structure of the dialect. This section is not intended to provide an in-depth description of stress assignment of HA, but to provide a general overview and the basics about stress assignment of HA.

The factors that determine the assignment of stress in Arabic are the syllable weight and position (McCarthy & Prince, 1990; Kager, 1995; Hayes, 1995; Hammond, 2011; Watson, 2011). Syllable patterns vary in the several dialects of Arabic and to what extent the stress assignment surpasses in a right to left direction where it could cover three or even four syllables, i.e. ultimate, penultimate, antepenultimate and

preantepenultimate (Watson, 2011). In languages that are syllable weight-sensitive like Arabic and English, stress is always assigned to the heaviest syllable; otherwise it could be assigned to a light syllable (Hayes, 1995).

In spite of those differences in the several dialects of Arabic, they all follow two main stress assignment rules. First, stress is assigned to the rightmost superheavy syllable. Second, if there is no superheavy syllable, then stress is assigned to a heavy penultimate syllable. In the case of lacking a rightmost superheavy syllable and a penultimate heavy syllable, Arabic dialects differ in which syllable get stressed. In that case, in HA and the majority of Arabic dialects the stress is assigned to a heavy antepenultimate syllable, which indicates having a *three-syllable window* limitation, i.e. the stress can be assigned to ultimate, penultimate or antepenultimate, but it never retreats to the preantepenultimate syllable of a word (Erpenius, 1656; Abdo, 1969; Mitchell, 1960; Brame, 1970; Bohas and Kouloughli, 1981; Angoujard, 1990; and Watson, 2011). The same thing is reported in Kuwaiti Arabic (Aldaihani, 2014).

HA stress distribution is illustrated in the following tables from Table 2-8 to Table 2-12 bellow. In addition to the monosyllabic word, there are disyllabic, trisyllabic and polysyllabic examples. In HA, as well as most of Arabic dialects, the stress assignment rules in HA are as follows: stress is assigned to the ultimate/ right-most superheavy syllable. In the absence of the right-most superheavy syllable, the stress is assigned to the penultimate superheavy syllable. No antepenultimate superheavy syllable in the elicited data of HA. Therefore, the next step for the stress assignment is to stress a heavy penultimate. The antepenultimate heavy syllable is stressed in HA if the other two syllables are light. Finally, stress is assigned to the antepenultimate light syllable when all syllables are light. However, the long vowel effect of stress assignment of the syllables in HA is beyond the scope of this thesis.

Table 2-8: Stress Right-most superheavy syllable in HA:

	Syllable structure	**HA words**	**Gloss**
1	CVCC	[ˈbiʃt]	‘cloak’
2	CV.CVCC	[ʤa.ˈlast]	‘I sat’
3	CVC.CVCC	[san.ˈdart]	‘I froze’
4	CV.CVC.CVCC	[ta.laʕ.ˈθamt]	‘I stuttered’
5	CVC.CV.CVCC	[ʔin.ta.ˈʕaʃt]	‘I refreshed’
6	CV.CVVC	[zi.ˈbiːl]	‘date basket’

Table 2-9: Stress superheavy penultimate syllable in HA:

	Syllable structure	**HA words**	**Gloss**
1	CVVC.CV	[ˈseːr.ha]	‘her belt’
2	CVVC.CVC	[ˈdaːr.kum]	‘your room’
3	CCV.CVVC.CVC	[ʃta.ˈheːt.hum]	‘I desired them’
4	CVC.CVVC.CV	[tan.ˈnuːr.ti]	‘my skirt’
5	CCVVC.CV	[ˈgduːr.na]	‘our pots’
6	CCVVC.CVC	[ˈsduːrkum]	‘your chests’

Table 2-10: Stress heavy penultimate syllable in HA:

	Syllable structure	**HA words**	**Gloss**
1	CVC.CV	[ˈkub.ri]	‘a bridge’
2	CVC.CVC	[ˈtar.tar]	‘sequin’
3	CVC.CVC.CV	[kin.ˈdar.ti]	‘my shoe’
4	CVC.CVC.CVC	[ʃar.ˈbak.tik]	‘I tangled you’
5	CV.CVC.CVC	[mu.ˈhan.dis]	‘an engineer’

Table 2-11: Stress heavy antepenultimate syllable in HA:

	Syllable structure	**HA words**	**Gloss**
1	CVC.CV.CV	[ˈkam.bi.li]	‘my blanket’
2	CCVV.CV.CV	[ˈswaː.ri.ta]	‘his bracelet’
3	CCVC.CV.CV	[ˈmˤqɑbˤ.jɑ.ha]	‘hidden’

Table 2-12 Stress light antepenultimate syllable in HA

	Syllable structure	**HA words**	**Gloss**
1	CV.CV.CV	[ˈħa.ʃa.rah]	‘a bug’’
2	CV.CV.CV	[ˈsa.lˤɑ.tˤɑh]	‘salad’
3	CV.CV.CV	[ˈʕa.ra.bah]	‘a wagon’

HA, along with different Saudi Arabian dialects exhibits the same stress pattern. There is no secondary stress in HA, but a primary one (Prochazka, 1988 and Al Sadhaan, 2015).

2.6 Conclusion

In this chapter offered a description of some aspects of the phonology of HA including the segmental inventory, i.e. consonants and vowels. Attention has been drawn toward specific segments of interest to this study, i.e /q/, /ɢ/, and /g/. With the presence of /q/ as an active phoneme in HA, the velar /g/, however, is argued to be a phonemic segment in HA whereas the uvular /ɢ/ is argued to be both a phonemic as well as an allophonic segment in HA. Examples from local HA words are presented to support this claim. The syllable structure is presented and discussed. Since the stress is not relevant to my analysis, only basic stress patterns and assignments in HA are illustrated with examples and discussed.

3 Chapter Three: Theoretical Background

3.1 Introduction

This chapter is geared toward a concise background information including the phonetic correlation of the pharyngealisation and uvularisation in HA. Some acoustic examples and measurements conducted via PRAAT will be presented in section 3.2. The emphasis spread triggered by pharyngealised and uvularized segments will be presented by the feature [RTR], which will be discussed along with feature geometry in section 3.3. After that, a theoretic overview of Optimality Theory (henceforth OT) will also provide a basic review of Classical / Parallel OT and HS-OT as the framework to analyze the phonological phenomena investigated in this study in section 3.4 and 3.5. Finally, the rationale and motivation for adopting the Harmonic Serialism Optimality Theory framework for this study will be explained and an example from HA is presented within the HS-OT framework in comparison to the Classical OT.

3.2 Phonetic correlates of emphasis in HA

The emphasis that is triggered by the pharyngealized and uvular segments is a complex phonological phenomenon in which a combination of phonetic correlates create the impression of "*mufaχχam"* 'darkness/ heaviness'. These phonetic correlates are articulatory correlates, acoustic correlates in addition to some enhancing correlates such as lip-rounding (Harrell, 1957 p. 69; Lehn, 1963 p. 30; Al-Nassir, 1993; Watson, 2002 p. 270).

The articulatory correlates of emphasis are manifested in the enlargement of the oral cavity and the constriction in the pharyngeal cavity. This enlargement is responsible for the resultant auditory heaviness during the pronunciation of emphatics and other segments in their vicinity. Lip-protrusion and lip-rounding is an obvious enhancing feature to the pharyngealisation phenomenon in some dialects of Arabic:

Lebanese, Yemeni, Cairene as it has been in MSA as well (Haddad, 1983; Kenstowicz, 1994 p. 42; Bettini, 1985; Lehn and About, 1965 p. 271; Harrell, 1957 p. 69-70; Holes, 1995 p. 56; Watson, 2002 p. 270).

Although some literature studies identify the root of the tongue as the secondary articulator of the pharyngealized segments, and a primary articulator of the uvular segments. While other studies argue that the production of the pharyngealised and uvular segments does not involve the root of the tongue, they rather involve the back of the tongue, i. e. *dorsum* of the tongue (Bin-Muqbil, 2006; Zawaydwh, 1999; McCarthy, 1994b; Jongman et. al. 2011).

The phonetic dispute over the secondary articulation of the pharyngealised emphatics has led to adversity of terms proposed referring to the emphasis triggered by such segments in Arabic, i.e. /tˤ, ðˤ, sˤ/ (Al-Solami, 2013). In general, both pharyngealised and uvular segments are articulated with the tongue dorsum. However, the pharyngealised segments are articulated with body of the tongue being "*more depressed*". Whereas the uvular segments are articulated with dorsum of the tongue is "*retracted*" further (Gazeli, 1977; Al-Solami, 2013 p. 316).

The articulatory correlate of the pharyngealised and uvular segments from several studies in literature vary regarding the nature of the actual nature of the secondary articulation (Al-Ani, 1970; Ali & Danilofff, 1972; Gianni & Pettorino[10], 1982; Watson, 2002; Trubetzkoy, 1969; McCarthy, 1994; Zawaydeh, 1999). However, it appears plausible that the retracted back of the tongue is the main articulator, which is referred to as [RTB] feature in some studies such as (Ali & Danilofff, 1972; Catford, 1977; Zawaydeh, 1999). Whereas the retracted tongue root which is referred to as [RTR] feature is a resultant of the movement of the body of the tongue further back in the vocal tract. This means that the root of the tongue is a dependent articulator correlate for the pharyngealised and uvular segments as opposed to the

[10] In Iraqi Arabic.

[RTB] being an independent and the main articulator correlate for the pharyngeal segments in Arabic (Al-Ani, 1970; Al-Solami, 2013).

On the other hand, the acoustic correlates show contingent formant frequencies in the spectrogram between F_1 and F_2 in particular. Although the acoustic correlates of the emphatics exhibit the effect of F_1 raising, lowering F_2, on the other hand, is the imminent acoustic correlate of emphatics in recent studies, to mention a few: (AL-Ani, 1970; Kuriyagawa, 1984; Younes, 1993; McCarthy 1994; Watson, 2002; Newman, 2002; Newman and Verhoeven 2002; and Al Masri and Jongman 2004; Bellem, 2007; Shar and Ingram 2010;). In a spectrogram, F_1 indicates the height of the vowel, F_2 indicates the backness of the vowel and F_3 indicates the labialisation 'rounding' feature. Consequently, vowels in the pharyngealisation environment exhibit a rising in F_1, lowering in F_2 and a rising in F_3 (Al-Masri and Jongman, 2004; Jongman et al. 2011 p. 89).

The emphasis spread affects the quality of adjacent segments, i.e. both consonants and vowels. The consonants change from a plain to a pharyngealised version such as /l/ → [lˤ] (Ferguson, 1956; McCarthy, 1994). As to the vowels, in an emphasis environment, the central low vowel /a/ tend to change into a further back vowel [ɑ] (Ferguson, 1956). According to Embarki et. al. (2007) pharyngealisation is mostly associated with the low central vowel /a/ which is, in their opinion, the primary trigger for the pharyngealisation. As a result, they propose the use of low back vowel /ɑ/ instead of the low central vowel /a/ to indicate the existence of the pharyngealisation effect (Embarki et. al., 2007). Furthermore, in his study of the pharyngealised fricatives /sˤ, ðˤ/ in Arabic, Alosh (1987) notes that the emphasis effect is greater with the low vowel /a/ than the high vowels /i, u/. Jongman, et al. (2011) also report the difference in the lowering of F_2 from /æ/ to /ɑ/ is larger than the lowering of F_2 for both /i/ and /u/. They attribute this large difference in the lowering in the low vowel to "*the lack of contrast in backness for the low*

vowel" (Jongman, 2011 p. 94).[11] On the other hand, AL-Ani (1970) provides allophonic pharyngealised vowels to vowels /a/, /u/ and /i/ corresponding to the pharyngealisation environment as /ɑ/, /ʉ/ and /ɨ/.[12]

Many scholars report a similar emphasis effect triggered by the uvular segments /χ, ʁ, q/ in which the F_2 of an adjacent vowel is lowered and the emphasis spreads to the other segments in their vicinity. Emphasis triggered by uvulars in Arabic is mostly associated with low back vowel /ɑ/ (Ferguson, 1956; Abumdas, 1985; Elshafei, 1991; McCarthy, 1994a, 1994b; Ingham, 1994; Zawaydeh, 1997, 1998, 1999; Hanson, 2001; Watson, 1996a, 1996b, 2002; Shahin, 2002; Bin-Muqbil, 2006; Shar and Ingram, 2010). Although the uvulars /χ, ʁ, q/ have a similar emphasis effect over adjacent segments in Arabic, the degree of emphasis is not as heavy as that of the pharyngealised segments. Meaning the lowering of F_2 in the vicinity of the uvular segments /χ, ʁ, q/ is not as significant as the lowering of F_2 in the vicinity of the pharyngealised segments /tˤ, dˤ, ðˤ, sˤ/. As a result, Ferguson (1965) calls the uvularisation triggered by the uvular segments /χ, ʁ, q/ "*semi-emphasis*".

Nonetheless, the emphasis effect of /q/ is debatable. Hanson (2001) argues that while /ʁ, χ/ has the phonological feature [+RTR], /q/ on the other hand, has an unspecified feature [+/-RTR]. Whereas according to Gouma (2011) and Owen (2013), the emphasis from the uvular /q/ is limited and spreads to the adjacent vowels only not / "*never*" to adjacent consonants. In addition, according to them the velar /g/, as a part of the guttural class has a similar emphasis effect in the vicinity of /ɑ/ (Gouma, 2011; Owen, 2013).[13] Associating the emphasis of /g/ to the adjacency to the back vowel /ɑ/ suggests that the source of emphasis

[11] Moreover, Al-Masri and Jongman (2004), also examine the '*spectral mean*' of the segments /dˤ, tˤ, sˤ, ðˤ/. The spectral mean of the emphatic stops /dˤ, tˤ/ exhibited an emphasis effect through a low spectral mean while the emphatic fricatives /sˤ, ðˤ/ did not exhibit an emphasis effect through no change in the spectral mean. The emphasis effect from adjacency to the emphatic fricatives /sˤ, ðˤ/ was not as strong as the emphasis effect of the adjacency to emphatic stops /dˤ, tˤ/ in Jordanian Arabic.

[12] For more details, please refer to the explanation at the beginning of his book (Al-Ani, 1970).

[13] McCarthy (1994b) reports that the velar /g/ has an emphasis effect similar to that of the pharyngealised /sˤ, dˤ, tˤ, ðˤ/ and uvular /χ, ʁ, q/. however, it is more plausible to think that it is actually a further back version of the voiced velar stop, i.e. a voiced uvular stop /ɢ/ in the vicinity of the vowels /ɑ, ʉ, ɨ/.

is actually the back vowel /ɑ/ and not the velar /g/.

By proposing the feature [pharyngeal], McCarthy (1994b), groups the segments: pharyngealised, uvulars, pharyngeals and laryngeal in one natural class "*Gutturals*"[14] and their common acoustic cue is a high F_1. It is not, however, the primary acoustic correlate for the emphasis triggered by the pharyngealised and uvular segments, which in this case is the low F_2. Whereas the high $F_1$is the main acoustic cue for the pharyngeal segments /ħ, ʕ/ (Watson, 2002).

As mentioned above, a lowered F_2 of the vowels in an emphasis environment is the imminent acoustic correlate of pharyngealisation and uvularisation. The examples in Table 3-1 below are from HA. They exhibit the pharyngealised segments /tˤ, ðˤ, sˤ/ and their plain counterparts /t, ð, s/ in the vicinity of the low back vowel /ɑ/ since the pharyngealisation is mainly associated with it. The examples in Table 3-2 on the other hand exhibit the uvular segments /χ, ʁ, q/ in the vicinity of /ɑ/ as well. The F_2 measurements are provided for comparison of all the examples.

Table 3-1: Pharyngealisation effect of /tˤ, ðˤ, sˤ/ in HA

	Eaxmple	**Gloss**	**F_1**	**F_2**	**F_2 to F_1 spread**	**F_2 drop in /ɑ:/ vs. /a:/**
/tˤ/	/tˤɑ:lˤ/	'overdue'	852 Hz	1225 Hz	373	603
/t/	/ta:l/	'drag'	780 Hz	1828 Hz	1048	
/ðˤ/	/ðˤɑ:lˤ/	'remain'	517 Hz	1015 Hz	498	820
/ð/	/ða:l/	'humiliate'	344 Hz	1835 Hz	1491	

[14] Although the study is focused on Palestinian Arabic, more about the phonetic analysis about the laryngeal can be found in Shahin (2011).

/sˤ/	/sˤɑːlˤ/	'attack'	919 Hz	1204 Hz	285	700
/s/	/saːl/	'spill'	655 Hz	1904 Hz	1249	

The lowering in F_2 is attested in Arabic as triggered by the pharyngealised segments, in the case of HA, the three segments /tˤ, ðˤ, sˤ/ is shown in the table above. The low F_2 in the pharyngealised environment indicates an emphasis spread. The lower the F_2 drops, the heavier the emphasis degree will be and the further the emphasis spread with in the word boundary. In order to decide the degree of pharyngealisation, i.e. '*the degree of constriction*' the measurements of F_2 are given in the table above in both environments the pharyngealised segments /tˤ, ðˤ, sˤ/ and their plain counterpart segments /t, ð, s/ for comparison. Accordingly, the F_2 measurement differences for vowels /ɑ/ and /a/ in the vicinity of /tˤ/ vs./t/, /ðˤ/ vs. /ð/ and /sˤ/ vs. /s/ are: (603 Hz), (820 Hz) and (700 Hz) respectively. On the other hand, the higher F_2 measurements of /a/ in the plain counterparts, the coronal segments /t, ð, s/ indicate no emphasis spread over the adjacent segments. The column labelled F2 to F1 spread, exhibits the degree of emphasis by showing the spread distance between the two formants. The difference in the lowering of F2 in the vicinity of pharyngealised vs. uvular segments is presented in table (3-2) below.

Table 3-2: Uvularisation effect of /χ, ʁ, q, ɢ/ in HA

	Eaxmple	**Gloss**	**F_1 of /ɑ(ː)/**	**F_2 of /ɑ(ː)/**
/χ/	/χɑːrˤ/	'drip'	613 Hz	1119 Hz
/ʁ/	/ʁɑrˤ/→ [qɑrˤ]	'ripe'	806 Hz	1038 Hz
/q/	/qɑːlˤ/	'exaggerate'	854 Hz	1223 Hz
/ɢ/	/ɢɑːlˤ/	'fried'	849 Hz	1131 Hz

However, the lowering of F_2 in the uvular environment is attested in some dialects of Arabic, their emphasis effect is considered neither strong nor extensive as the emphasis spread triggered by the pharyngealised segments. The examples from HA in the Table 3-2 above show a significantly low F_2 following the uvulars /χ, ʁ, ɢ/. The F_2 following the uvular /q/, however, is not significantly low as the other uvulars, i.e. /χ, ʁ, ɢ/. Nonetheless, the low F_2 in the vicinity of /χ, ʁ, q, ɢ/ indicates an emphasis spread. The measurements of F_2 are given in Table 3-3 for both the pharyngealised segments /tˤ, ðˤ, sˤ/ and the uvular segments /χ, ʁ, q, ɢ/ for comparison in order to determine the emphasis degree effect of uvulars 'uvularisation', in HA.

Table 3-3: Emphasis degree of /tˤ, ðˤ, sˤ/ vs. /χ, ʁ, q, ɢ/ in HA

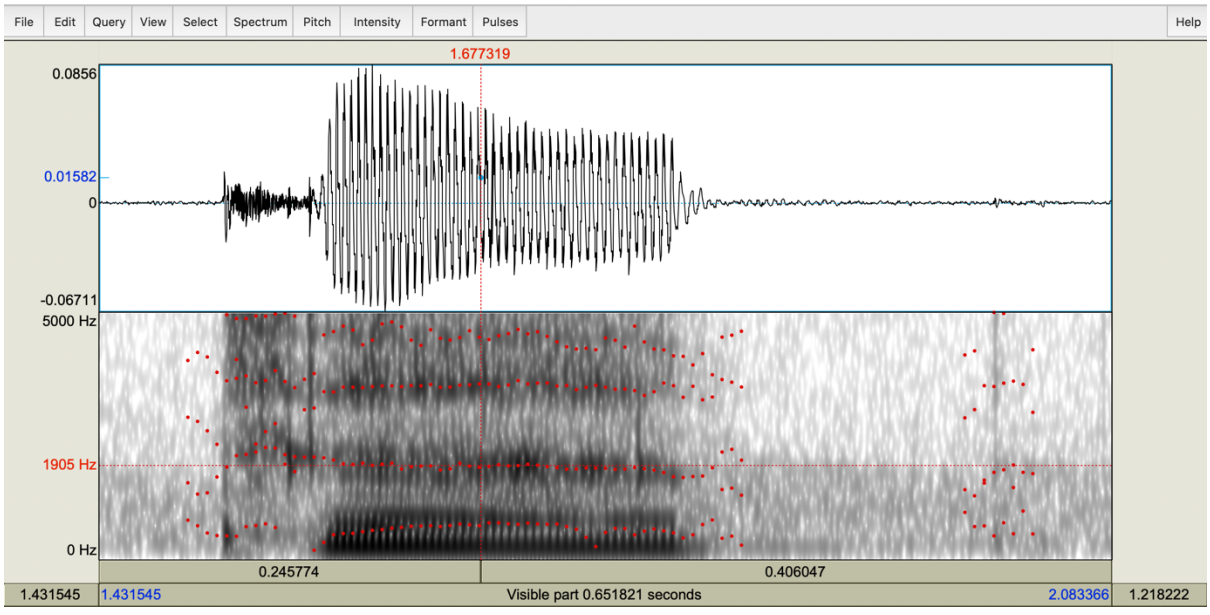
	Segments	**F_2 to F_1 spread**
Pharyngealised	**/tˤ/**	373 Hz.
	/ðˤ/	498 Hz.
	/sˤ/	285 Hz.
Uvular	**/χ/**	216 Hz.
	/ʁ/	238 Hz.
	/q/	367 Hz.
	/ɢ/	282 Hz.

The column labelled F2 to F1 spread in Table 3-3 above means The degree of emphasis refers to how close the two formants (F1 and F2) are to each other during the articulation of a pharyngealised and uvula sound. The closer they are, the smaller the value, the heavier the emphasis becomes and vice versa.

With the exception of uvular /q/in some examples, F_2 measurements in Table 3-3 reveal that in HA the uvular segments /χ, ʁ, ɢ/ have a heavier emphasis effect, 'degree of emphasis,' on adjacent vowels manifested in lower F_2 than those adjacent to the pharyngealised segments. This contradicts what has been reported in the literature regarding the emphasis spread triggered by uvulars /χ, ʁ, q/. For examples, the emphasis spread of the uvulars is weak to the point that Ferguson (1965) calls their emphasis effect "*semi-emphasis*".

The following screenshots are the spectrograph pictures obtained from PRAAT, from the recorded HA data, which belong to one of the participants in this study. They show the emphasis effect triggered by different emphatic segments in HA. All the examples presented below belong to the same female speaker. More spectrographic screenshots of HA examples with the F2 measurements are presented in appendix 3.

Spectrogram 3-1 No emphasis spread from the plain segment /t/ in HA



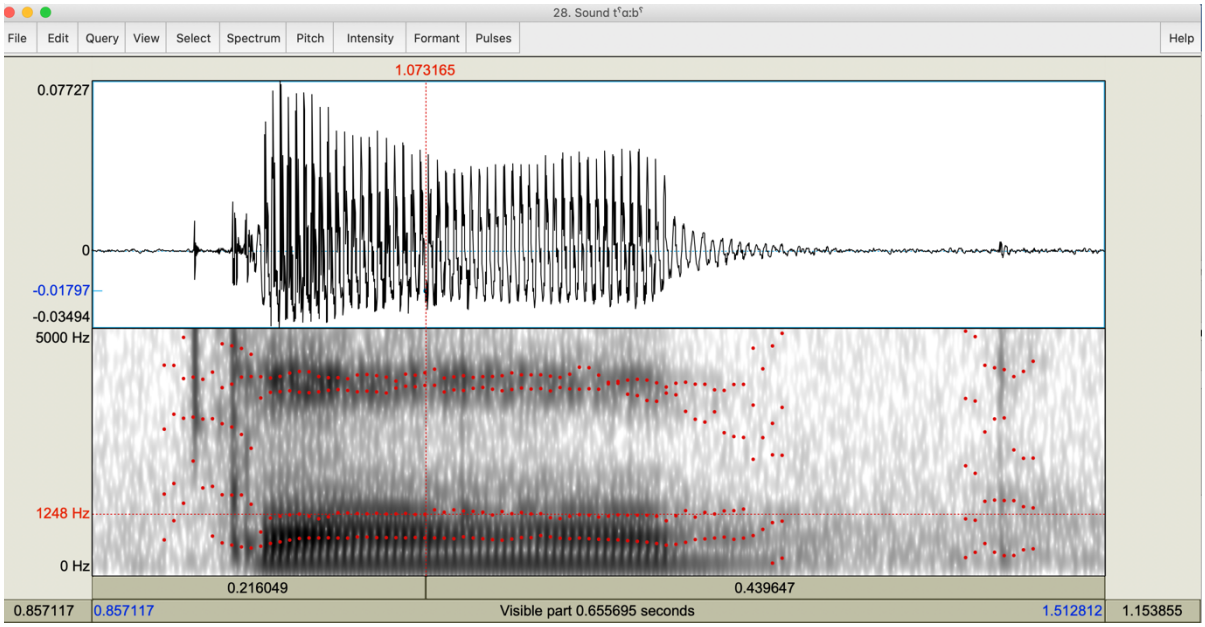
t a: b

No emphasis spreading of the plain segment /t/, female HA speaker. A horizontal marker indicates a midpoint F2 frequency showing the F2 measuring at 1905 Hz.in the word [ta:b] 'repent'.

Spectrogram 3-1 above, shows no emphasis effect is triggered from the plain segment /t/ in [ta:b] 'repent'.

The emphasis effect would show as the two formants, the dotted red lines, get closer to each other. This spectrogram shows that F1 and F2 are further apart. The red dotted lines that appear in the spectrogram are produced by the formant's tracker in PRAAT and have the program measure it for you. It estimates the values of the formants and it is more accurate than trying to do it manually. In order to obtain the measurements of F1 and F2, using the cursor I highlight a portion of the vowel that I want to measure, in the midpoint (40ms), then the formants readings are obtained from the formant listing drop menu. F1 measures at 701 Hz and F2 measures at 1905 Hz as the red horizontal marker indicates.

Spectrogram 3-2 Progressive emphasis spread triggered by the pharyngealised /tˤ/ in HA



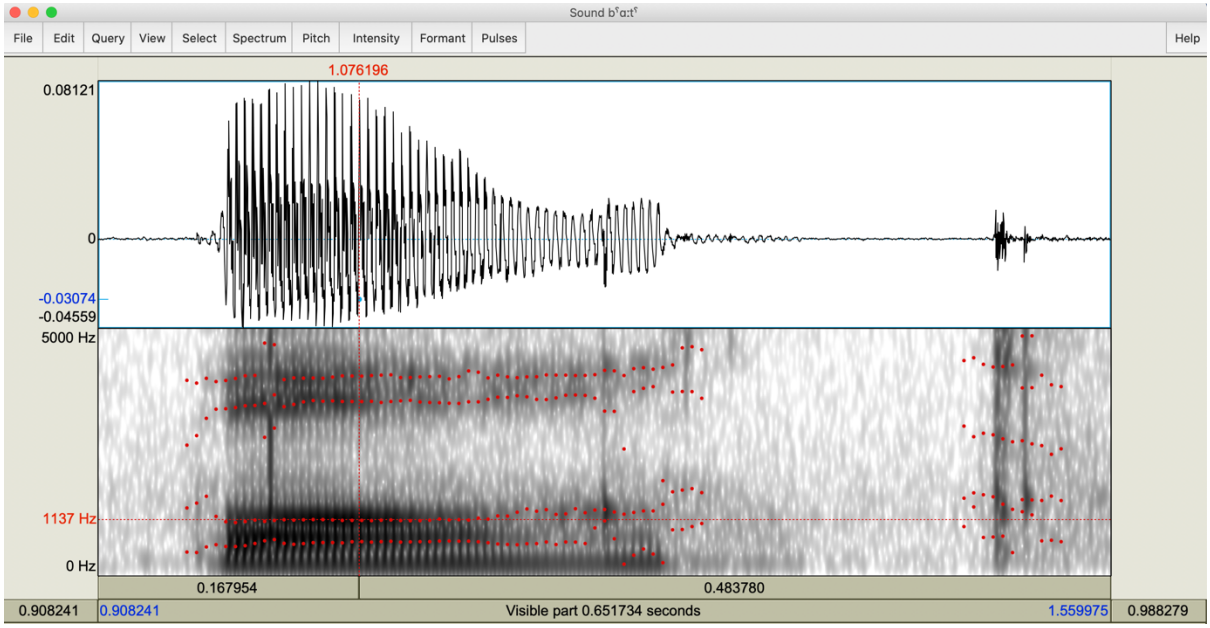
tˤ ɑː bˤ

Progressive emphasis spreading triggered by the pharyngealised segment /tˤ/, female HA speaker. A horizontal marker indicates a midpoint F2 frequency measuring at 1248 Hz. In [tˤɑɑbˤ] 'scrumptious'.

One the other hand, Spectrogram 3-2 shows how dramatically F2 drops to a low value in the adjacency to an emphatic segment, in this case it is the pharyngealised /tˤ/, compared to the high value of F2 in Spectrogram 3-1 in the adjacency of the plain counterpart /t/. this spectrograph depicts the word [tˤɑːbˤ] 'scrumptious'. The F1 shows a rise than the previous example at 769 Hz. Whereas F2 shows a heavy drop

measuring at 1248 Hz. The direction of the emphasis spread is progressive since the trigger /tˤ/ is in word-initial position. The degree of pharyngealisation/ non-pharyngealisation between the two examples in Spectrogram 3-1 and Spectrogram 3-2 can be measured by calculating how close the two formants F1 and F2 are. The difference is roughly 500 Hz.

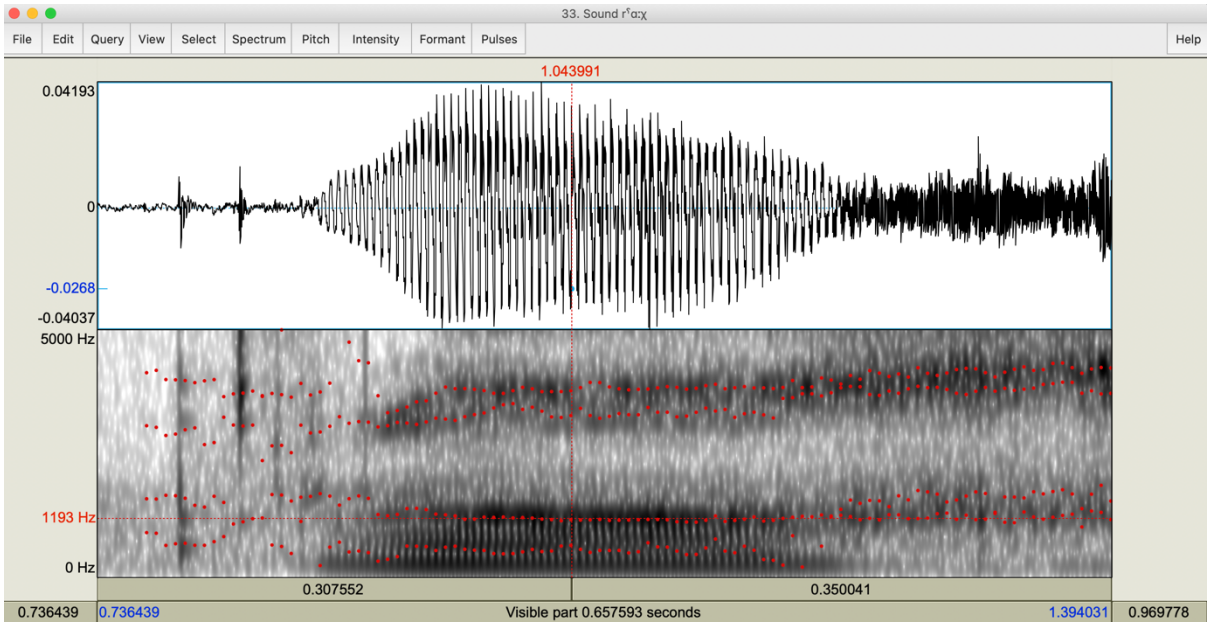
Spectrogram 3-3 Regressive emphasis spread triggered by the pharyngealised /tˤ/ in HA



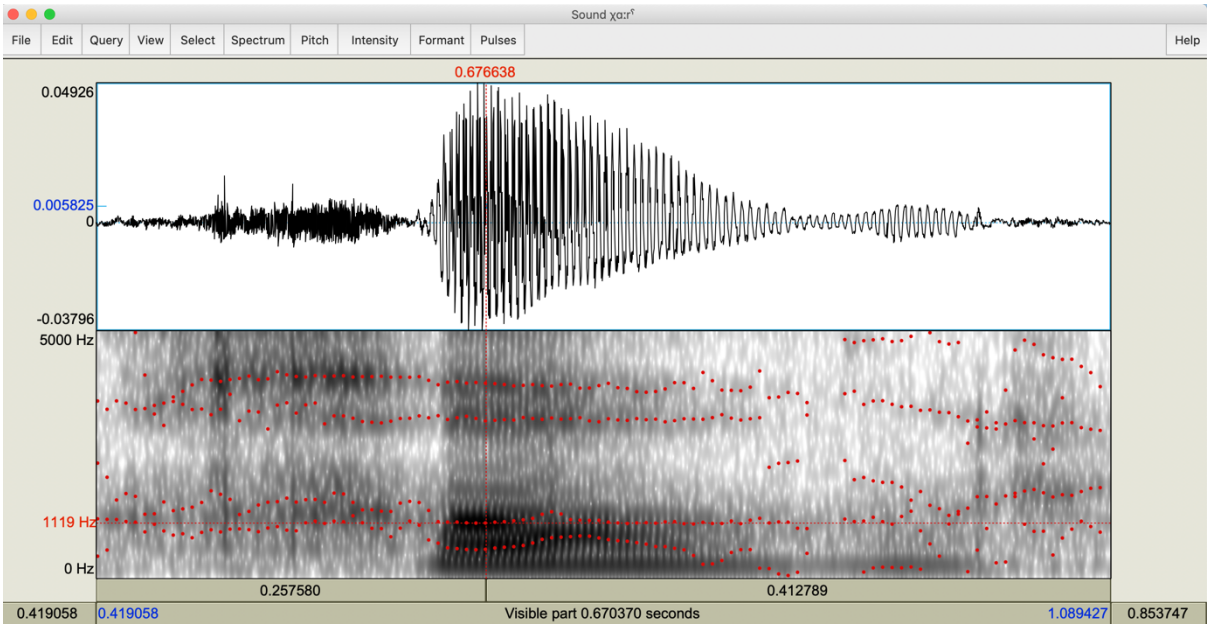
Regressive emphasis spreading triggered by the pharyngealised segment /tˤ/, female HA speaker. A horizontal marker indicates a midpoint F2 frequency measuring at 1137 Hz. In [bˤɑːtˤ] 'ruptured'.

Moreover, Spectrogram 3-3 depicts the word [bˤɑːtˤ] 'ruptured'. It shows the emphasis effect triggered regressively by the pharyngealised segment /tˤ/ since it occurs at word-final position. F1 measures at 692 Hz and F2 measures at 1137 Hz. It is worth noting that the pharyngealisation spreads throughout the entire word in HA. Furthermore Spectrogram 3-4 below shows the emphasis effect triggered by the uvular segment /χ/ in HA in two directions: regressively and progressively. The other uvular segments /q, ɢ, ʁ/ have similar uvularisation effect in HA as presented earlier in this section and proven acoustically.

Spectrogram 3-4 Emphasis triggered by the uvular /χ/ in HA



rˤ ɑː χˤ



χˤ ɑː rˤ

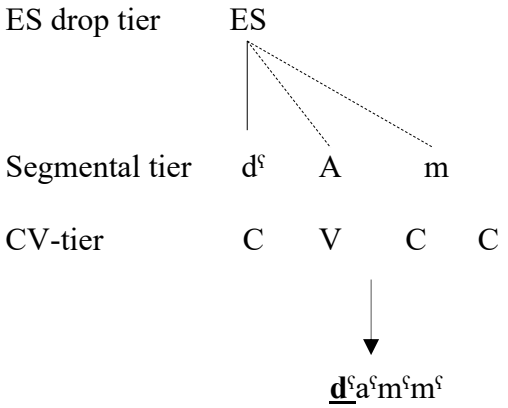
The top one shows a regressive emphasis spreading triggered by the uvular segment /χ/, female HA speaker. A horizontal marker indicates a midpoint F2 frequency measuring at 1193 Hz. in [rˤɑːχ] ‘luxorious’. While the bottom one shows a progressive emphasis spreading with the F2 measuring at 1119 Hz. in [χɑːrˤ] ‘drip’.

Spectrogram 3-4 shows the radically drop in the F2 in the adjacency to the uvular segment /χ/. The top spectrograph shows the word [rˤɑːχ] a regressive uvularisation spread in which F1 measures at 639 Hz. Whereas F2 measures at 1193 Hz. The bottom spectrograph shows the progressive uvularisation spread with the F1 measuring at 613 Hz. While F2 measures at 1119 Hz in the word [χɑːrˤ] 'drip'. It is worth noting that the pharyngealisation. It is worth noting that the uvularisation effect has a long distance spread in HA that cover the entire word. This is very interesting about HA. In addition, the HA data show a heavier emphasis effect triggered by the uvular segments progressively, i.e. uvularisation than the emphasis effect that is triggered by the pharyngealised segments regressively, i.e. pharyngealisation. More details about pharyngealisation and uvularisation as well as the analysis of the phenomenon from a HS-OT will be presented in chapter four.

The emphasis spreading phenomenon, i.e. pharyngealisation and uvularisation is, at its heart, an assimilation process that displays how far within domains, i.e. a syllable or a word, the emphasis feature can reach. This assimilation could be a local-distance assimilation being applied minimally within the syllable, or it could be a long-distance assimilation covering the whole phonological word. In a local-distance assimilation instance, the assimilating segments are strictly adjacent to each other. For example, the place of articulation assimilation of /n/ ~ /m/ when it is adjacent to the bilabial segment /b/, so /ʤanb/ → [ʤamb] 'side'. Whereas in a long-distance assimilation instance, the assimilating segments are not strictly adjacent to each other, but within the same domain, i. e. within the same word boundaries. For example, the pharyngealisation effect of /tˤ/ on the adjacent segments through the entire word domain in the Arabic word /tˤaːħ/ → [tˤɑːħˤ] 'fall' where both /aː/ and /ħ/ copied the emphasis feature of /tˤ/ and surfaced with a pharyngealised quality /a/ ~ [ɑː] and /ħ/ ~ [ħˤ]. The assimilation in a pharyngealisation

phenomenon involves feature spreading (Goldsmith, 1976 a, b)[15]. The temporal range of the feature expands and the feature extends to cover more than one segment insofar as it may cover a whole word domain (Goldsmith, 1976 a, b; McCarthy, 2009). Figure 3-1 below illustrates that the organisation of segments and features in autosegmental phonology is done through association lines. The range of a feature expands by spreading those association lines in a string of segments.

Figure 3-1: Autosegmental representation by Card (1983, p. 134)



Several features are suggested in the literature to distinguish the emphatics from the non- emphatic segments in Arabic. These features represent the salient feature of emphasis which is mainly manifested in the drop of F_2. Among those features are: [+Flat], [+F2 Drop], [pharyngeal], [+RTR] '*Retracted Tongue Root*' and [RTB] '*Retracted Tongue Back*' (Jakobson,1957; Card, 1983; McCarthy, 1989, 1991, 1994b; Davis, 1993,1995; and Zawaydeh, 1997) respectively. The features will be addressed in more details in section § 3.3 below.

[15] The core principle of autosegmental phonology is feature spreading.

3.3 Feature geometry of pharyngealised and uvular segments in HA

In the analysis of segments in phonology, features play a significant role since each segment consists of a set of distinctive features that distinguish the segments phonemically. The resultant of grouping these features variously, is a large number of sounds (Clements, 1985 p.225; Clements and Hume, 1995, p. 245; Hume and Odden, 1996, p. 345). These features are coordinated in a tree of features called '*feature geometry*' (FG) in which features that pattern together are grouped together hierarchically.

The FG sets out the features that pattern together and are most likely to share phonological processes under nodes in a tree dominated by a topmost node called '*root node*'. Both features and classes are governed by the root node. The feature geometry by Clements (1985) is one of the first formal models of FG. Whereas several models have been proposed by other scholars, to mention a few, such as (Sagey, 1986; McCarthy, 1988, 1991, 1994; Rice and Avery, 1993). The proposed in the literature FG models differ greatly in the number of nodes and how the features are handled; in Clements FG for instance, the organization of the features of the tree is based articulatorily (Halle *et. al*, 2000 p. 389-390). In this study, however, I will basically refer to the FG by Clements and Hume (1995) with the additional modifications adopted from a combined version of the FG from McCarthy (1994); Vaux (1993) and Davis (1995) to suit the analysis of the pharyngealisation and uvularisation the in HA.

The adopted FG models from McCarthy (1994) and Davis (1995) implement the feature [pharyngeal] in order to differentiate the oral articulators from the passive articulator, i.e. labial, coronal and dorsal, and pharyngeal or guttural respectively. McCarthy's (1994) model is specifically designed to analyse the guttural sounds in Semitic languages where he argues that the uvular segments /χ, ʁ, q/ are articulated in the upper pharynx whereas the pharyngeal segments /ħ, ʕ/ are produced in the epiglottal region in the middle of the pharynx and finally the laryngeal segments /h, ʔ/ are produced by the glottis in the larynx. Therefore, the node [pharyngeal] is included under a place node.

Another modification also adopted in this study is the division of place node into two branches as in the FG by Vaux (1993) and Davis (1995), i.e. one branch is labelled the upper vocal trac (UVT) which represent the oral articulators: (labial, coronal, dorsal) and the lower vocal trac (LVT) which represent the passive articulators in the pharyngeal region: (pharyngeal, laryngeal, uvular, pharyngealised). In addition, the two branches of the place node are labelled (1place) and (2place) for the main place of articulation and the secondary place of articulation respectively following Davis (1995).

This study is essentially based on/ uses (a) HS-OT as the analytical approach in order to provide a thorough analysis for the phenomena under investigation, i.e. pharyngealisation, uvularisation and uvular segmentalternations in HA. Since the FG in this study is used for illustrational purposes, comparison or justification for the chosen FG over the others is not needed. The aim of using specific versions of FG in this study is to utilise relevant models and to provide a phonological evidence through a demonstration of the effect of the emphasis spread triggered by a pharyngealised and / or a uvularised consonant on target segments in their vicinity[16]. The list of features of the relevant HA sounds under investigation is shown in Table 3-4 below.

[16] Emphasis spread is one of the formal terms for the effect triggered by a pharyngealised and / or a uvular consonant is which is referred to in literature as pharyngealisation process.

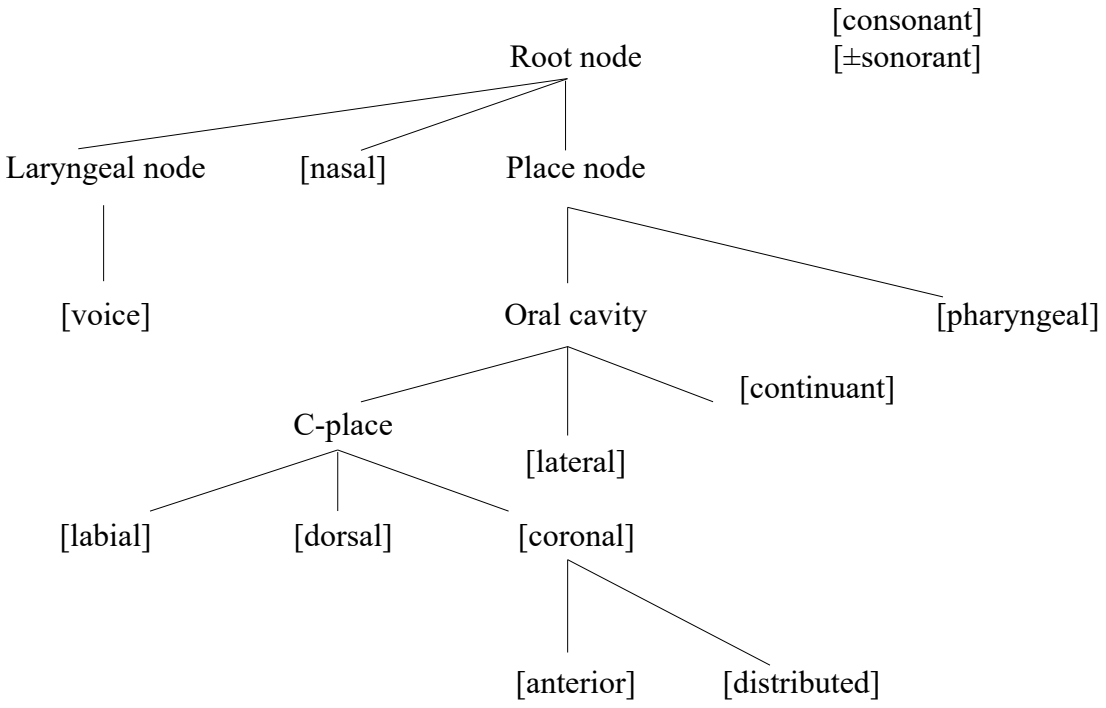
Table 3-4: Features of relevant sounds in HA

Features in HA	b	t	d	k	g	q	ʔ	tˤ	m	n	r	f	θ	ð	s	z	ʃ	χ	ʁ	ħ	ʕ	h	ðˤ	sˤ	ʧ	ʤ	w	j	l
Consonant	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+
Sonorant	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+
approx.	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+
Continuant	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+			+	+	-
Nasal	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lateral	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Voice	+	-	+	-	+	-	-		+	+	+			+		+			+		+		+			+	+	+	+
Coronal		✓	✓					✓		✓	✓		✓	✓	✓	✓	✓						✓	✓	✓	✓		✓	✓
Anterior		+	+					+		+	+		+	+	+	+	-						+	+	-	-		-	+
Distributed		+	+					+		±	-		+	+	-	-	+						+	-	+	+		+	±
Labial	✓								✓			✓															✓		
Dorsal				✓	✓	✓												✓	✓										
High	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+	-
pharyngeal						✓	✓	✓										✓	✓	✓	✓	✓	✓	✓					
RTR	-	-	-	-	-	±	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	+	-	-	-	-	-
Back	-	-	-	+	+	+	-	+	-	-	-	-	-	-	-	-	-	+	+	+	+	-	+	+	-	-	+	-	-
Low	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-

The FG in Figure 3-2 below is mainly based on the FG in Clements and Hume (1995) with the addition of the [pharyngeal] node by McCarthy (1994) and Davis (1995) for the purpose of analysing the pharyngealisation phenomenon. The FG in Figure 3-2 shows the phonological features of HA assimilation[17]. Whereas the FG in Figure 3-3 shows the combined FG from McCarthy (1994) and Davis (1995) including the modification of Clements and Hume's (1995) FG with the addition of the node [pharyngeal]:

[17] There will be a reference to some assimilation processes in HA in this study such as voice assimilation, place of articulation assimilation and manner of articulation assimilation which include fronting of some segments in chapter 5.

Figure 3-2: A modified Clements and Hume's (1995) FG



As Figure 3-2 above illustrates that the root node dominates all the features and classes. The major class features are: [±consonant] that distinguishes the consonants from vowels; [±sonorant] that distinguishes the sonorant consonants with the value [+sonorant] and the obstruent with the value [-sonorant]; the laryngeal feature distinguishes the voiced segments with the value [+voice] and the voiceless one with the value [-voice]. In order to combine the FG of McCarthy's (1994) model with Clements and Hume's (1995) model, and in order to distinguish active articulators, i.e. (labial, coronal and dorsal) from passive ones, i.e. (pharyngeal), the oral cavity is placed under the place node.

The manner feature [±continuant] distinguishes the fricative consonants [+continuant] from the stop consonants [-continuant]. The trill is a [+continuant] segment whereas the lateral is distinguished by the manner feature [+lateral], but [-continuant] in HA according to Johnstone (1976) since the lateral patterns with the stops. The same thing is reported in related dialects of Arabic such as Kuwaiti Arabic

(Johnstone,1976; Alharbi, 1991; Aldaihani, 2014) and Qatari Arabic (Mustafawi, 2006). The [±anterior] and [±distributed] features are related to the coronal consonants that are produced in the front part of the tongue[18].

The FG in Figure 3-3 below shows a combination of FG from McCarthy (1994) and Davis (1995) including the node [pharyngeal] for the pharyngeal /ħ, ʕ/ and the laryngeal /ʔ, h/ segments respectively. The FG in Figure 3-3 shows the addition of the place node labelled (1place) since pharyngeals and laryngeals are simple segments with one place of articulation in the LVT:

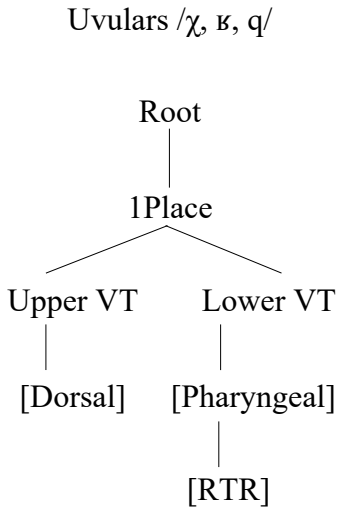
Figure 3-3: FG of pharyngeal and laryngeal segments:

Not only does the FG from McCarthy (1994) and Davis (1995) can handle simple segments with one place of articulation such as the pharyngeal and the laryngeal segments as shown in Figure 3-3 above, their combined FG can handle complex segments such as uvular and pharyngealised segments as well since they classify them as a natural class, i.e. *gutturals*. The uvular segments /χ, ʁ, q/ are complex in the sense that their place of articulation falls in the back of the tongue '*the dorsum region*' as well as in '*the*

[18] The coronal consonants and their specified features are beyond the scope of this study.

pharyngeal region'[19]. They are produced when the tongue first moves backwards and then upwards creating a constriction in the upper pharynx region. The uvular segments /χ, ʁ, q/ are represented in the FG in Figure 3-4 below in which the place node (1place) branches into UVT and LVT.

Figure 3-4: FG of uvular segments

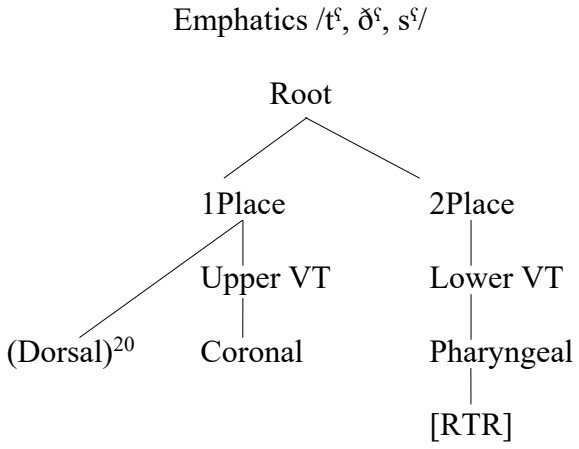


Whereas the pharyngealised segments /tˤ, ðˤ, sˤ/ are complex in the sense that they have two places of articulation, i.e. the primary place of articulation is the coronal, which is represented in the FG in by the place node (1place) in the UVT and the secondary place of articulation is the pharyngeal, which is represented in the FG by the place node (2place) in the LVT in the FG from McCarthy (1994) and Davis (1995). The pharyngealised segments /tˤ, ðˤ, sˤ/ are primarily produced in the coronal region while the tongue root is retracted towards the back of the pharynx creating a pharyngeal constriction simultaneously (Ladefoged, 2014). In Arabic, pharyngealisation involves the spreading of the feature [+RTR] 'retracted tongue root' from the trigger, emphatic segments /tˤ, ðˤ, sˤ/, to the consonants and vowels in their vicinity

[19] Uvulars are argued to have a secondary articulation in literature (Van de Weijer, 2015).

with its domain and extent varies from one dialect to another (Shosted *et. al* 2017). They are represented in the FG in Figure 3-5 below.

Figure 3-5: FG of Emphatic segments



The main focus of here is on the pharyngealised segments /tˤ, ðˤ, sˤ/ as well as the uvular segments /q, ʁ, χ/ in HA and their effect on adjacent segments, i.e. the pharyngealisation and/ or uvularisation of the adjacent consonants and 'backing'/ lowering of the adjacent vowels (Shosted *et. al* 2017). Although many features are proposed in the literature to represent the emphasis effect of the emphatics / the pharyngealised and the uvular segments, and although the difference between them is noticeable, it however, has not been established systematically. I will adopt Davis [RTR] feature to represent the emphasis features, i.e. [RTR] and spreading, which is triggered by both sets the pharyngealized as well as the uvular segments in HA[21]. As a result, and for analytical purposes, the feature [RTR] is added to the FG in both figures (3-4) and (3-5) above. It is worth noting that, as presented above, the feature [RTR] is secondary in the pharyngealised segments and the spread feature easily covers the entire word without blockers in HA.

[20] The (Dorsal) feature is added in parentheses to indicates its absence in the underlying representation according to McCarthy (1994b).
[21] I will be referring to the emphasis spread that is triggered by the uvulars in HA as uvularisation.

Whereas in the uvular segments, the [RTR] feature is primary and the spread feature is interestingly goes long-distance covering the entire word as well. Therefore, the feature is added to the HS-OT framework as well as a markedness constraint SPREAD [RTR] in order to carry out a phonological analysis of pharyngealisation and uvularisation in HA.

The following section focuses on the theoretical perspective in analysing the phonological processes under investigation. Generative phonology was the dominant theory in phonological analysis before OT until the early 1990s represented by Chomsky & Halle's (1968) "*Sound Pattern of English*" (SPE), i.e. that uses re-write rules to represent an actual spoken phonetic output generated by the reformulation of the re-write rules from an abstract phonological underlying structure. There are two branches of Generative Phonology: a. linear phonology represented by SPE Chomsky & Halle (1968) as its' basic theory, Natural Generative Phonology (Vennman, 1974; Hooper, 1976) and Natural Phonology (Donegan, 2002). b. the nonlinear[22] phonology represented by subsequent nonlinear developments include Autosegmental Theory (Goldsmith, 1976), Metrical Theory (Liberman & Prince, 1977 and Prince, 1983), Feature Geometry (Clements, 1985) and the growing recognition of the importance of output constraints has contributed to the development of the constraint-based theory the Optimality Theory (OT) (Prince & Smolensky, 1993/2004; McCarthy & Prince, 1993; Kager, 1999).

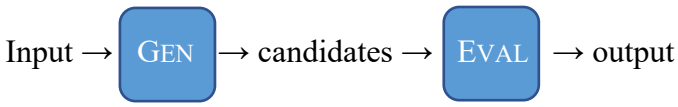
3.4 Optimality Theory

The basic idea of OT a relationship between an underlying form and a surface form, referred to in OT respectively as input and output forms. OT is an output constraint-based framework in which the constraints interact with one another. The popularity of OT is due to its ability or applicability to other aspects of several linguistic phenomena. OT framework is practical, which allows for cross-linguistic analysis of

[22] Nonlinear means not only linear (Al-Hindawi & Al-Adili, 2018). Nonlinearity is not an OT feature. However, its characteristic is the output. I look at the input; the output is known. In a way, OT goes backwards.

the formal structural properties of the grammar as well as its developments and variations. OT is a mechanism that operates two main functions: to generate many/ infinite set of candidate inputs by the Generator (GEN) then to pass the candidates through the second function for Evaluation (EVAL) to evaluate each candidate against a set of constraints (CON). The candidate with the least number of violations and satisfies a highly ranked constraint is the winner and therefore dubbed optimal output[23] (McCarthy, 2007a; de Lacy, 2010). The model of OT is illustrated in Figure 3-6 below (McCarthy, 2000 p. 2):

Figure 3-6 model of OT



The selection of the optimal output is dependent on the constraint hierarchy of a language. The main assumption of OT about constraints is that they are ranked, universal and violable (McCarthy, 2008a p. 10).

The ranking of constraints is justified by having '*conflict, winner, no disjunctions'* (McCarthy, 2008a p. 41- 42) However, in situations where constraints display no conflict then that means the constraints are equal with no dominance relationship, a dotted line is drawn to signify the lack of dominance relationship between the constraints as shown in Tableau 3-3. The optimal candidate in such situation is the one that satisfies both constraints. No change in the choice of the optimal output would result from a reversed order of the constraints (McCarthy & Prince, 1993).

[23] In (Prince & Smolensky, 1993 p.191) "*Richness of the base (ROTB)"* or Freedom of the input as presented in (McCarthy & Prince, 1993; van Oostendrop & Hermans, 1999) applies at the underlying level to the extent that a language may have an underlying form that cannot be pronounced which in turn can transform to a pronounceable output form and even to a totally different surface form "*/kæt/ into [dɔg]*" (Sheredi, 2015 p. 50) meaning that the underlying form or the input, although debatable, is free from any restriction or constraints.

Constraints in OT are universal, i.e. all languages share the same universal constraints *'Universal Grammar'*. However, their ranking hierarchy is language-specific. The constraint that is ranked high in one language may be ranked low in another. The activity of these constraints also differs in each language. The constraints that are active in one language may not be active or they may be active, yet dominated by other highly ranked constraints in other languages. A constraint is considered active if it is highly ranked and if it affects the choice of a candidate to be a winner '*optimal'* or a loser candidate. The activity of constraints differs on different sets of candidates, a constraint that is active on a set of candidates may be not active on a different set of candidates. McCarthy (2008a, p. 22) A constraint that is ranked lower gets activated when the optimal candidate and at least one competitor 'tie' on the constraints that are ranked higher. Only when one or more candidates '*tie*' on the highly ranked constraints will the lower ranked ones be active constraints.

Unlike previous theories, the constraints in OT are violable. However, for a constraint to be the highest in ranking does not mean it cannot be violated by some candidates. That could happen in some circumstances, but the candidate with the least number of violations '*minimal violation*' to the highest-ranking constraint will be preferred and chosen to be the optimal one.

Nevertheless, not all constraints are violable. A constraint that is the highest in the hierarchy within the grammar of a language is '*undominated'*. Since onsetless syllables do not exist in Arabic, for example, this means the constraint ONSET is inviolable/ *undominated*. In (5) below, the constraints organisation within a grammar is illustrated (Sherrard, 1997 p. 47):

(5)

Inviolable constraints >> Ranked violable constraints >> Inactive constraints[24]

[24] The symbol (>>) here refers to an outranking relationship between the constraints.

Serial derivations are not present in the analysis of Classical OT. This is attained in parallel within one single mapping, which explains the reference to this version of OT as Parallel OT (McCarthy, 2000, 2010).[25] From a set of candidates generated by the GEN the input to output mapping applies directly in a single EVAL process by the conflicting and strictly ranked constraints on the basis of well-formedness to determine the optimal output. In addition, all the constraints are laid over one layer '*stratum'* in Classical OT, hence parallel OT (McCarthy, 2000, 2010). The relationship between the constraints in Classical OT is dominance while their interaction is represented by *'tableaux'*.

CON_1 dominates CON_2, CON_2 dominates CON_3 and consequently CON_1 exhaustively dominates CON_3 as illustrated in (6) below (de Lacy, 2010):

(6)

$CON_1 >> CON_2 >> CON_3$

Classical OT has overcome challenging problems and phenomena faced by previous hypotheses such as conspiracy. Yawelmani conspiracy problem resolved with the use of constraint interaction. In order to avoid three consonant clusters word initially *CCC, Yawelmani utilises the repair strategies of consonant deletion as in Tableau **3-1** and vowel insertion as in Tableau 3-2. The tableaux are adopted form Rakhieh (2009 p. 21):

[25] Parallel OT is also referred to as Harmonic Parallelism (HP) in comparison to Harmonic Serialism (McCarthy, 2000, 2010).

Tableau 3-1 Consonant deletion C→Ø C+_____C in Yawelmani

/gi.tiːn + hnil/	*COMP	MAX-C_{stem}	MAX-C/__ v	DEP-V	MAX-C
a) ☞gi.tiːn.nil					*
b) gi.tiːn.hnil	*W				L
c) gi.tiːh.nil		*W			*
d) gi.tiːn.hil			*W		*
e) gi.tiːn.hi.nil				*W	L

Tableau 3-2: Vowel insertion Ø→V/C___C {#, C} *in Yawelmani*

/ʔilk+ hin/	*COMP	MAX-C_{stem}	MAX-C/__ v	DEP-V	MAX-C
a) ☞ʔi.lik.hin				*	
b) ʔil.khin	*W			L	
c) ʔil.hin		*W		L	*W
d) ʔil.kin			*W	L	*W

The above tableaux show examples of conspiracy in Yawelmani. A consonant is deleted to avoid * CCC sequence; Normally the deleted consonant is the second one as in (5a) where /h/ in /gi.tiːn.hnil/ is deleted since it is not part of the stem → [gi.tiːn.nil]. Whereas just after the first consonant of *CCC a vowel is inserted C<u>V</u>CC, as in (6b) /ʔilk.hin/ → [ʔi.lik.hin].

However, other phonological phenomena such as *phonological opacity*, *process interaction* and some cases of *variation* remained unsolved by the original version of OT (Prince & Smolenskey, 1993/2004). Consequently, modified and developed versions of Classical OT have therefore appeared,

namely HS-OT. This new version of OT identifies the intermediate levels, the notion of harmonic gradual change and the powerful characteristic of GEN with one change at a time in the limited list of the generated competing candidates to account for such unsolved phenomena, which require a serial phonological analysis.

The current study focuses on three phonological processes i.e. pharyngealization, uvularisation and uvular segment alternations in HA rather than the sole purpose of statistical variation, predictions and the occurrence frequencies of possible variants in the investigated dialect. HS-OT framework will prove sufficient in accounting for the processes investigated here.

The alternation phenomena, i.e. sound change between uvula segments /ʁ/ and /q/, is one of the goals of this research. However, this alternation is not being investigated statistically. The alternation in this study is not based on the multiple or possible different ranking of constraints, it is rather about the changes or alternations that a segment undergoes through several derivational steps and not through one single EVAL step, i.e. process interaction. This study focuses on explaining some phonological processes in HA including a uvular alternations phenomenon within the framework of HS-OT which is the topic of the next section. It will also shed light upon inclusive assimilation processes of manner of articulation assimilation, voice assimilation amongst uvular segments and emphasis spread in HA. This study does not aim to explain a variation phenomenon quantitatively. The frequency of the possible variable outputs is beyond the scope of this study, therefore StOT is eliminated and left for future research.

3.5 Harmonic Serialism OT (HS-OT)

HS-OT is a derivational version of OT that recognises the intermediate levels. It is first mentioned in Prince and Smolensky (1993/2004). In addition, HS is also mentioned in other studies in literature including, amongst others, (Black, 1993; and Blevins, 1997). HS, however, was not pursued in those studies

where Classical OT/ Parallel OT was favoured over HS. Then, McCarthy has reconsidered HS in (2000, 2002, 2007b, 2008a, 2008b, 2009, 2010, and 2016) in which general implications of HS have been discussed and established.

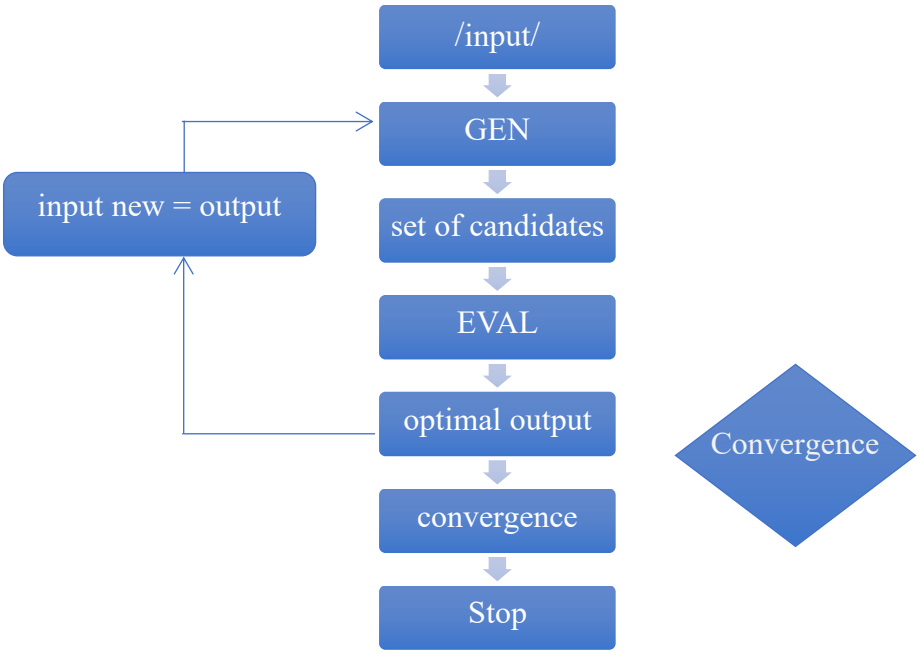
Constructing derivation is a property that HS shares with other derivation theories presented in the literature. There are few similarities and many differences between HS and the rule-based phonology (RBP) presented in (Chomsky & Halle, 1968). HS and RBP both postulate intermediate representational derivations; and both postulate limitations on the number of changes from one derivational step to another. Nevertheless, the evaluation in HS is different. It is based on the ranking of universal constraints that compare candidates rather than language-specific RBP rules. HS also shares the derivation feature with other versions of OT, i.e. OT with candidate chains (OT-CC) (McCarthy, 2007a) and Stratal OT (Kiparsky, 2000, 2003)[26]. For more discussion about OT and RBP see (McCarthy 2002, p. 66-138).

Two main properties that distinguish HS from other versions of OT: that are *Gradualness* and *Harmonic improvement* until convergence. The first property is that GEN in HS is restricted by the *gradualness* property, which means that only one change is allowed for the candidates in each derivational step, i.e. one faithfulness constraint is violated at each derivational step. *"Because there can be many changes from the input to the output, the output of each pass through Gen and Eval is submitted as the input of another pass through Gen and Eval. This Gen→Eval→Gen→Eval loop continues until no further changes are possible"* (McCarthy, 2010 p. 3). The second property is the *harmonic improvement*, which meant that derivations must demonstrate a monotonous harmonic improvement in each step since *"harmony is the property that EVAL selects for"* (McCarthy, 2016 p. 58). For the harmonic improvement to be

[26] Syntactic theories such as Chomsky's Government Binding (1982) and Minimalism (1995) share the derivation feature with HS.

guaranteed, the ranking of constraints in HS is strict. In other words, the constraint ranking does not change from one step to the next in HS (Kimper, 2011; Staubs and Pater, 2016). The HS-OT model as presented in McCarthy (2016, p. 50) shows the flow chart (1) below:

Flowchart (1) HS-OT model



Flow chart (1) above demonstrates the derivation process within HS-OT. The output from one derivational step becomes the input to the next one and so on. The loops of output to GEN loops keep going until the convergence happens, then the derivation is complete. "In HS, the input to GEN is not necessarily the underlying representation, so it can have a structure that has been assigned by the grammar" (McCarthy, 2016 p. 71).

An illustration of the analysis within HS is presented in Tableau 3-3 below from an example in HA where this consonant clusters is not allowed in word-initial position due to SSP and a resyllabification process is in order. In such an instance, two segments are inserted a high vowel /i/ and a glottal stop /ʔ/,

e.g. /nquːtˁ/→ [ʔinquːtˁ] ‘dowary’. Due to the nature of GEN in HS, the insertion of two segment simultaneously is not possible since one of HS characteristics is having at most one simple change in every derivational step. *“Because HS’s* GEN *is limited to doing one thing at a time, it cannot epenthesize both of these segments simultaneously”* (McCarthy, 2010 p. 3). The mapping /nquːtˁ/→ [ʔinquːtˁ] needs intermediate derivational steps. First, the vowel /i/ is inserted to satisfy the highly ranked constraints *M/SON. Whereas the insertion of the glottal stop /ʔ/ is left to a subsequent step to satisfy ONSET.

Tableau 3-3 *HS analysis of HA: /nquːtˁ/→ [ʔinquːtˁ]*

(3-3-a) Step 1: Vowel insertion

/nquːtˁ/	*M/SON	CONTIG	ONSET	DEP	MAX
a) nquːtˁ	*				
b) ☞ inquːtˁ			*	*	
c) niquːtˁ		*			

In the first step of the derivation, the winner is [inquːtˁ] since it is the intermediate candidate that will lead to the final optimal output [ʔinquːtˁ] in the coming steps. The candidate set includes the input form /nquːtˁ/ as a faithful candidate along with another unfaithful candidates that differs from the input by one change at most: /inquːtˁ/ and /niquːtˁ/ . In order for [inquːtˁ] to be chosen as the optimal output at this step, the constraints *M/SON and CONTIGUITY[27] must dominate ONSET and DEP. Although the winner violates both ONSET and DEP at this step, it satisfies the highly ranked constraints *M/SON and CONTIGUITY.

[27] (Pas, 2004)

(3-3-b) Step 2: Glottal stop insertion

/in.quːtˤ/	*M/SON	CONTIG	ONSET	DEP	MAX
a) in.quːtˤ			*		
b) ☞ ʔin.quːtˤ				*	

The input in the second step is /in.quːtˤ/, which is the winner in the first step. It is evaluated by the same grammar and led to the harmonic optimal output [ʔin.quːtˤ]. Although [ʔin.quːtˤ] violates DEP by the addition of the epenthetic glottal stop /ʔ/, it however satisfies a highly ranked constraint ONSET that dominates DEP.

(3-3-c) Step 3: Convergence

[ʔin.quːtˤ]	*M/SON	ONSET	CONTIG	DEP	MAX
a) ☞ [ʔin.quːtˤ]					

The third step shows the convergence [ʔin.quːtˤ], which is the input to this step of derivation since it is the winner from the previous one. Once again the surface form [ʔin.quːtˤ] wins as the optimal output. At this point, no further improvements are possible to [ʔin.quːtˤ] and therefore the loop of GEN/ EVAL terminates once the mapping shows identical input and output forms. This means an input: *"has realised all of its potentials for harmonic improvement under this grammar"* (McCarthy, 2010 p. 4).

Tableau 3-4 Classical OT analysis of HA /nquːtˤ/→ [ʔinˌquːtˤ]

/nquːtˤ/	*M/SON	ONSET	CONTIG	DEP	MAX
a) nquːtˤ	*!				
b) uːtˤ		*!			**
c) inˌquːtˤ		*!		*	
d) ☞ niˌquːtˤ			*!	*	
e) nˤɢtˤ	*!				*

Because of the nature of GEN in Classical OT, which generates infinite set of candidates, that means any candidate can be a possible output. Unfortunately, this also means the list of candidates may contain a candidate that satisfies the constraints as an optimal output, but it is not the optimal, yet accepted, lexical item in the dialect as shown in Tableau 3-4 above with the winning candidate [niˌquːtˤ]. Since the mapping is a direct evaluation with one single step unlike HS, then the constraint ONSET must dominate CONTIGUITY so they do not exhibit any conflict and are not violated by the surface form [niˌquːtˤ]. As a result, the winner output in (d) violates the constraint CONTIGUITY which militates against separating a string of segments, but it satisfies the two highly ranked constraints *M/SON and ONSET. However, the optimal output in this mapping is not included in the candidate list, which is [ʔinˌquːtˤ], this leads to the wrong output to be chosen as the optimal form as long as it satisfies the higher constraints.

It is very useful when studying the HS derivation is to use the *harmonic improvement tableau* as illustrated in Tableau 3-5 adopted from (McCarthy, 2016 p. 59). This tableau exhibits the faithful candidate along with the winner output in every derivational step. It shows how the harmony improved in every step until the derivation converges and therefore terminates.

Tableau 3-5 *Harmonic improvement tableau*

		*M/SON	CONTIG	ONSET	DEP	MAX	
Faithful	/nquːtˤ/	1					
Step 1	/in.quːtˤ/				1	1	
Step 2	/ʔin.quːtˤ/					1	
Step 3	[ʔin.quːtˤ]						*Convergence*

The harmonic improvement tableau shows the gradual and harmonic improvements in the mapping of an input in finite number of derivational steps until convergence. In Tableau 3-3 the mapping of /nquːtˤ/→ [ʔin.quːtˤ] occurs in three derivational steps </nquːtˤ/, /ʔin.quːtˤ/, [ʔin.quːtˤ]>.

In contrast, in the HS when a constrain does not show a conflict with other constraints then this constraint is unranked with respect to the other constraint, i.e. the ranking is not established and dotted line is used between these constraints. This is the case of the constraint DEP and MAX in (tableaux 3-3 a, b and c) or it can be excluded if there is no need for it in the analysis of the data, meaning the constraint is not active. It is worth noting that the HA example illustrated in Tableau 3-3 in a HS-OT analysis with derivational steps above will be presented below in Tableau 3-6 including two more processes, i.e. voice assimilation and uvularisation spread justifying the adoption of HS-OT framework in this study giving its ability to tackle complex phenomena.

3.5.1 Justification for Harmonic Serialism OT

The properties of HS-OT of having derivational steps with intermediate outputs is of advantage to allow for a description of the phenomena under investigation such as the uvular /ʁ/ → [q] alternations phenomenon. After several analysis attempts with Classical OT and Anttila's model (2007), this complex phenomenon cannot be analysed otherwise. Since the frequency of the variable outputs is beyond the scope of this study, StOT [28]was also eliminated.

HS-OT is able to tackle complex phenomena such as those that involve multi-process phonological derivations that shows process interactions. Many examples including multi-process derivations are presented in McCarthy (2016 p. 57) and McCarthy et al. (2016). In such a situation, an order of the interacting processes must be asserted and the constraint ranking necessary to compel such an order must be affirmed as well. The first process which involves inserting two segments is presented above in Tableau 3-3 above. The interaction between the other processes is illustrated in example (9) and Tableau 3-6 below:

The ranking of the constraints is asserted in the following example from HA in order to for the processes to apply in the correct order, SSP and a resyllabification, voice assimilation and emphasis spreading processes are in order. In such an instance, two segments insertions a high vowel /i/ and a glottal stop. Then a voice assimilation /q/→ [ɢ]. Finally, the spreading of [RTR]. The first process, resyllabification in order to satisfy the SSP, is presented above in Tableau 3-3, so the following are the derivational steps that start from the output after the insertion of the glottal stop, which will be the input in to the next derivation for voice assimilation /ʔin.quːtˁ/ all the way through to emphasis spread. The details of such analysis and examples is discuss and presented in details in chapter four and more complex examples in chapter five.

[28] StOT is a developed version of OT: a mathematically powered mechanism that is concerned with the frequency of variable possible outputs and offers accurate predictions (Evanini, 2006).

(9) Voice assimilation and emphasis spreading in HA:

a. /ʔin.quːtˤ/→ [ʔinˤ.ɢɯːtˤ] ‘dowary’

Tableau 3-6 *HS analysis of HA: /*ʔin.quːtˤ/→ *[ʔin.ɢɯːtˤ]*

(3-6-a) Step 1:

/ʔin.quːtˤ/	AGREE [VOICE]	MAX-IO [VOICE]
1. Voice assimilation		
a. ʔin.quːtˤ	*	
b. ☞ʔin.ɣuːtˤ		*

(3-6-b) Step 2:

/ʔin.ɣuːtˤ/	AGREE [VOICE]	HAVE VOICE	MAX-IO [VOICE]	NOLINK [VOICE]
2. Voice assimilation				
a. ʔin.ɣuːtˤ		*		
b. ☞ʔin.ɢuːtˤ			*	*

Tableau 3-6 in step 1 and step 2 show the ranking of constraints that allow for voice assimilation process derivation to apply. Where the segment /q/ loses its [-voice] specification since assimilating with the adjacent preceding segment /n/ in the voice specification feature [+voice], but first /q/→ [ʁ] then /ʁ/→ [ɢ]. For the loss of the [-voice] specification of /q/ to apply first, the constraint AGREE [VOICE] must outrank MAX-IO [VOICE] since the winner [ʔin.ʁuːtˁ] in this step violates it.

The second step shows the continuous application of the voice assimilation process through adding a [+voice] specification by positing one markedness constraint: HAVE VOICE, which outranks MAX-IO [VOICE] and the faithfulness constraint NOLINK [VOICE], which is the lowest in the hierarchy. As such, the assimilation /ʔin.ʁuːtˁ/→ [ʔin.ɢuːtˁ] applies.

The third step on the other hand all the way through to the sixth step show the application of the second process: the emphasis spread process in HA. Since the gradualness and harmonic improvement are characteristics of the HS-OT framework, then each derivation is illustrated in a separated tableau.

(3-6-c) Step 3:

/ʔin.ɢuːtˁ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR] adj (X)	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
3. Emphasis spread						
a. ʔin.ɢuːtˁ			*			
b. ☞ʔin.ɢʉːtˁ						*

The emphasis from the pharyngealised segment /tˤ/ spreads regressively in the third step, but minimally to the adjacent vowel /uː/→ [ʉː] with the winner [ʔin.ɢʉːtˤ] satisfying the constraint SPREAD [RTR] adj (X). The next segment after the vowel /ʉː/ is the uvular segment /ɢ/ which by default is a trigger of emphasis in its own right. Therefore, the emphasis carries on to the next segment. The output of this step is the input of the following derivation.

The emphasis spread continues in step four with one segment at a time, where the emphasis regressively covers the coda of the first syllable. An additional constraint is added to ensure the spread covers the entire domain: SPREAD [RTR]-D, yet gradually. As a result, the winner in this step is [ʔinˤ.ɢʉːtˤ].

(3-6-d) Step 4:

/ʔin.ɢʉːtˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
4. Emphasis spread							
a. ʔin.ɢʉːtˤ			*	*			
b. ☞ʔinˤ.ɢʉːtˤ							*

(3-6-e) Step 5:

/ʔinˤ.ɢʉːtˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
5. Emphasis spread							
a. ʔinˤ.ɢʉːtˤ			*	*			
b. ☞ʔɨnˤ.ɢʉːtˤ							*

The constraint SPREAD [RTR]-D, in step five ensures the emphasis spreads regressively to the vowel /i/→ /ɨ/ resulting in the winner [ʔɨnˤ.ɢʉːtˤ]. The emphasis then continues regressively in the sixth step to the onset resulting in a total emphasized word [ʔˤɨnˤ.ɢʉːtˤ]. The winner in this step [ʔˤɨnˤ.ɢʉːtˤ] violates the lowest ranked constraint IDENT-IO [RTR], however it shows a total emphasis spread. No more harmonic improvements are possible at this stage. Therefore, the derivation stops and the convergence occurs in the seventh step when the input and the output are identical with the optimal output [ʔˤɨnˤ.ɢʉːtˤ].

(3-6-f) Step 6:

/ʔɨnˤ.ɢʉːtˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
6. Emphasis spread							
a. ʔɨnˤ.ɢʉːtˤ			*	*			
b. ☞ʔˤɨnˤ.ɢʉːtˤ							*

(3-6-g) Step 7:

/ʔˤin$^{\varsigma}$.ɢu:tˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
7. Convergence							
a. ☞ʔˤin$^{\varsigma}$.ɢu:tˤ							

In light of what has been presented above, HS-OT has proven efficient in the analysis of interacted phonological processes in HA with ease. That implies asserting an order for the application of the interacted processes is necessary for this HS-OT to work.

Furthermore, various phonological phenomena such as the assimilation processes, i.e. Voice assimilation, Place of articulation assimilation and Manner of articulation assimilation as well as various variation phenomena in literature. This raise the question of whether HS-OT would work in analysing the alternations in uvular segments in Hasawi Arabic beside other processes that may rise in this study.

Some studies in the literature have implemented aspects of HS-OT in their framework for investigating variation phenomena, particularly, local variation. To name a few: (Pater, 2007) and (Kimper, 2011). Pater (2007) notes that Serial Variation allows for a local variation account (Kimper, 2011, p. 2). Whereas Kimper (2011) proposes a combination theory of HS-OT and a multiple-ranking theory to tackle the variation phenomenon of local and global variation called "*serial variation*". In the theory of "*serial variation*" constraints have a different ranking in every step of the derivation, which he claims account for the local variable outputs such as the schwa deletion in French and the global variable outputs such as

the devoicing of labials in Warao[29]. The set of candidates in Kimper's theory "*serial variation*" is larger than that of HS. However, the convergence in such variable constraint ranking in every derivational step in *serial variation* is highly likely but not guaranteed (Kimper, 2011; Staubs and Pater, 2016).

3.6 A gap in the literature

The studies that have been carried out on HA are scarce in the literature in comparison with other dialects of Arabic like Cairene and San'ani (Watson, 2002). Earlier studies have reported various phenomena in HA (Johnstone, 1967; Fagali, 2004) the following studies are the ones I found in the literature dedicated to HA. Smeaton (1973) explored the history of the area, lexical expansion and loanwords with a brief review of phonetic properties of HA. Al Bohnayyah (2020) investigated sociolinguistic variation and change in the dialect of Alahsa from a sectarian aspect. HA is an under studied dialect within the framework of OT. There are, however, two studies that the studies that have analyzed the HA within the OT framework are scarce. Aljumah, (2008) and Sadhaan (2015) both investigated HA within the Classical OT framework. Aljumah, (2008) investigates the syllable shape and structure in HA. Whereas Al Sadhaan (2015) investigates prosodic structure and stress assignment in HA.

Although a study by Aldaihani (2014) examined the ability of HS-OT to analyze some phonological processes in Kuwaiti Arabic including Pharyngealisation and voice assimilation, I however, found no study dealing with phenomenon of alternations in Arabic within the framework of HS-OT. To the best of my knowledge, for a categorical alternation phenomenon, the framework of HS-OT has not been used in

[29] *"Local Variation: for a form with multiple loci of an optional or variable process, the choice at each locus may be independent from the choices at other loci"* (Kimper, 2011 p. 1). Whereas *"Global Variation: for a form with multiple loci of an optional or variable process, the choice must be the same at all loci"* (Kimper, 2011 p. 2).

the literature nor is there a study that analyses HA including the pharyngealization, uvularisation and uvular alternations within the HS-OT framework.

3.7 Conclusion

In this chapter, I have presented phonetic correlates of the emphasis effect triggered by the pharyngealised /tˤ, ðˤ, sˤ/ and uvular /q, ɢ, χ, ʁ/ segments in HA. That is shown in the acoustic measurements: lowering of F2 and raising of F1 in the vowels adjacent to these segments and spread to cover the entire word in both directions with no blockers. The feature of emphasis spread adopted in this study is [RTR] and a Feature Geometry is presented. The most interesting thing about HA is the fact that uvular segments trigger long distance emphasis spread, which is unexpected in comparison to what has been reported in the literature. A theoretical background of constraint-based phonology has been provided. The purpose of this chapter was to provide an example and analyze some of the phonological processes of the dialect under investigation by examining a constraint-based theory; namely HS-OT vs. Classical OT in order to provide a justification as to why HS-OT is chosen to analyze the phonological processes investigated in this thesis. As I have discussed later in this chapter how Classical OT is unable to capture complex processes in HA. Moreover, in chapter five more complex examples will be presented regarding the uvular alternations in HA. Due to the complex nature of choosing which one of the candidates is the optimal form in one single mapping in Classical OT, then HS-OT is adopted in this thesis. The investigated segments in the output candidates, although differ in the manner of articulation and the voice feature specification, they occupy the same place of articulation. The integration of OT and segmental phonology captures such a complicated phonological phenomenon with ease, given how in HS-OT this process of alternation is dealt with in harmonic and gradual derivational stages with strictly ranked constraints.

In HA, it will be shown how uvular alternation and uvularisation spread are gradual processes, since they are activated and triggered by consonantal, positional, vowels and complexity of the consonant clusters.

4 Chapter Four: Pharyngealisation and Uvularisation in HA from a HS-OT Perspective

4.1 Introduction

This chapter investigates the emphasis effect phenomenon in HA triggered by the pharyngealised and uvular segments in the dialect. First, A classification of these segments in HA will be presented in section 4.2 (as emphatics: pharyngealised and uvular) since they both exhibit emphasis effect; though they are considered part of the respect to the Guttural class in the literature. Then, the domain and the direction of emphasis spread in HA will be presented in section 4.3 and 4.4 in which examples of HA will be illustrated. The domains that will be covered are: lexical, across morphemic boundaries: prefixes and suffixes, and post-lexical in the environment of pharyngealised and uvular segments. The blockers of emphasis in HA will be presented in section 4.5. The degree of emphasis along with reference to the interaction between the type of trigger with the degree and the direction of emphasis will be presented in section 4.6 in which the uvular segments emphasis heavier progressively whereas the pharyngealised segments emphasis heavier regressively. Interestingly, the uvular segments in HA will show a long-distance emphasis spread. This long-distance spread is proven acoustically with the analysis PRAAT. In addition, a comparison between HA and other varieties of Arabic dialects will be drawn in section 4.6. Finally, HS-OT analysis of will be presented in section 4.7.

Emphatic segments of Arabic have been widely studied: from the Arab grammar scholars of the 8th century such as the renowned grammarian Sībawayh[30] to the recent Western grammar of Modern dialects of Arabic. The growing interest in Arabic emphatics is as a result of their unique properties and

[30] (Sibawayh, 1999)

phenomena, i.e. pharyngealisation and / or uvularisation[31]. Several studies with different approaches to the pharyngealisation phenomenon in Arabic are reported in the literature by Arab grammarians and in Western phonology. Pharyngealisation in Arabic is triggered by segments not only confined to the pharyngealised coronal segments, but also including uvular segments and, in some dialects of Arabic, pharyngeal segments as well (Watson, 2002).

The following are different definitions of what pharyngealisation means phonologically. Pharyngealisation and uvularisation are examples of assimilation phonological processes that involve the '*undergoer*' segments adjacent to the '*trigger*' segments, i.e. the pharyngealised and / or the uvular segments to assimilate to the emphasis feature within the syllable minimally and throughout the entire word maximally and sometimes across the word boundaries in connected speech (Cruttenden, 2001). It is an assimilation process in which segments assimilate to emphatic trigger in their vicinity. It is a coarticulation/ a secondary articulation in which /tˤ, ðˤ, sˤ/ are produced primarily in the coronal region while the tongue root/ dorsum is retracted creating a constriction in the upper pharynx simultaneously. The segments /tˤ, ðˤ, sˤ/ have the same place of articulation as their plain counterpart segments /t, ð, s/ except for the addition of the secondary articulation of the constriction in the pharyngeal region. This secondary articulation gives these segments their emphatic or heavy realisation (Mustafawi, 2006; Ldefoged, 2014; Shosted *et. al* 2017)[32].

The following examples in (4-1) below are of the minimal pairs of the pharyngealised segments /tˤ, ðˤ, sˤ/ and their plain counterparts /t, ð, s/ in HA. It is worth noting that, the voiced dental pharyngealised stop /dˤ/ is substituted with voiced inter-dental pharyngealised fricative /ðˤ/ whereas its plain counterpart is /d/ in HA as well as in the other varieties of the Gulf dialects spoken in Kuwait, Oman, Qatar, Bahrain

[31] In this study I will refer to the emphasis triggered by the pharyngealised coronals /tˤ, ðˤ, sˤ/ as pharyngealisation. Whereas I will refer to the emphasis triggered by the uvulars /q, χ, ʁ/ as uvularisation.

[32]Britannica, retrieved on 29/05/2020. URL https://www.britannica.com/science/phonetics/Secondary-articulations#ref583966

and The United Arab Emirates (Habib, 2012). The minimal pairs of pharyngealised and their plain counterparts' segments exist in different positions: word initial, word medial, and word finals as well as in the vicinity different vowels: /ɑ/, /ɨ/, /ʉ/ and /a/, /i/ and /u/ respectively. In HA, pharyngealisation occurs in different word positions in the adjacency of pharyngealised segments: initial, middle and final, the same as most Arabic dialects (Jongman et al., 2011 p. 88–89; Embarki, 2013 p.33).

Example 4-1 Minimal pairs of pharyngealised and plain counterpart segments in HA

	Segment	**Emphatic**	**Gloss**	**Plain**	**Gloss**
a.	**/tˤ/ and /t/**	/tˤɑlˤ/	'overlook'	/tat/	'hill'
		/fˤʉtˤʉːrˤ/	'breakfast'	/futuːr/	'lethargy'
		/bˤɨtˤ/	'hit'	/bit/	'decide'
b.	**/ðˤ/ and /ð/**	/fˤɑðˤ/	'rude'	/fað/	'unique'
		/ðˤʉrˤʉːfˤ/	'circumstances'	/ðuruːf/	'weeper'
		/ħɑðˤɨrˤ/	'ban'	/ħaðir/	'caucious'
c.	**/sˤ/ and /s/**	/rˤɑːsˤ/	'align'	/raːs/	'head'
		/sˤʉːrˤ/	'horn'	/suːr/	'fence'
		/ʕɑsˤɨːrˤ/	'juice'	/ʕasiːr/	'difficult'
d.	**/dˤ/ → [ðˤ] and /d/**	/ðˤɑːrˤ/	'harmful'	/daːr/	'house'
		/mˤɑfˤrˤʉːðˤ/	'imposed'	/mafruːd/	'straightened'
		/jˤɨðˤɨfˤ/	'overflow'	/jidif/	'push'

On the other hand, the occurrence of the emphasis effect which is triggered by the uvular segments /q, ɢ, χ, ʁ/ in HA is represented in examples (4-2) below: the emphasised lateral /lˤ/ in HA appears in the vicinity of the uvular segments /χ, ʁ, ɢ/ [χɑbˤɑlˤ] 'crazy', [qɑlˤɑ] 'precious' and [ɢɨfˤʉlˤ] 'lock'. In addition

to emphasis effect that spread from /χ, ʁ, ɢ/, the uvular stop /q/ appears to have an emphasis effect that spreads to cover the entire word /qaːʕ/→ [qɑːʕ] ‘bottom’. It is worth noting that the examples with /ʁ/ in the input surface with [q] in the output in HA. Therefore, /ʁalab/→ [qɑlˤɑbˤ] ‘he won’ and /ʁala/→ [qɑlˤɑ] ‘precious’.

Example 4-2 Emphasis of uvular segments /q, ɢ, χ, ʁ/ in HA

	Input	**Output**	**Gloss**
a.	/χaːl/	[χɑːlˤ]	‘my mother’s brother’
	/χabal/	[χɑbˤɑlˤ]	‘crazy’
b.	/ʁalab/	[qɑlˤɑbˤ]	‘he won’
	/ʁala/	[qɑlˤɑ]	‘precious’
c.	/ɢiful/	[ɢɨfˤʉlˤ]	‘lock’
	/ɢalb/	[ɢɑlˤbˤ]	‘heart’
	/ɢlaːs/	[ɢlˤɑːsˤ]	‘glass’ (loan word)
d.	/qaːʕ/	[qɑːʕˤ]	‘bottom’
	/waθθaq/	[wˤɑθˤθˤɑq]	‘authenticate’

From the examples in (4-2) above, the uvular fricatives /χ, ʁ/ and the uvular stops /q, ɢ/, they all have an emphasis spread effect in HA whether it is a monosyllabic word or longer, the emphasis spread persists. The following section offers a discussion and a classification of the segments under investigation, i.e. /tˤ, ðˤ, sˤ/ and /q, ɢ, χ, ʁ/ in HA, which attributes the use of the term pharyngealisation for the emphasis effect triggered by /tˤ, ðˤ, sˤ/. Whereas the term uvularisation is used for the emphasis effect triggered by /q, ɢ, χ, ʁ/.

4.2 Classification of emphatics and gutturals in HA:

This section investigates the classification of emphatic and guttural segments in HA. Examining each segment in terms of emphasis effect. Gutturals are "*sounds produced with a primary constriction in the posterior region of the vocal tract"* (McCarthy, 1994 p. 202). While emphatics are non-primary gutturals. They are complex segments that are primarily produced with coronal articulator and secondary pharyngeal articulator simultaneously (McCarthy, 1989). In addition, uvulars are complex segments that are primarily produced in the throat that is "*closest to the mouth"*, pharyngeal are primarily produced "*in the middle of the throat"* and laryngeal are primarily produced "*in the back of the throat"* (McCarthy, 1994 p.192).

As a result, segments that involve articulation in the back of the vocal tract are the pharyngealised emphatics, uvulars and gutturals: pharyngeal and laryngeal segments. For the sake of phonological analysis in this research, I will assume that in HA the pharyngealised emphatics /tˤ, ðˤ, sˤ/ and the uvulars /ʁ, χ, q/ are distinctive from the rest of the segments in the guttural class, i.e. pharyngeal /ħ, ʕ/ and laryngeals /h, ʔ/ on the basis of emphasis effect. They are different in the sense that the pharyngealised and uvular segments spread emphasis to segments in their vicinity within and / or across the word domain whereas the gutturals do not. Table 4-1 below illustrates the segments with emphasis effect and gutturals in HA.[33]

Table 4-1: Emphatics and gutturals of HA

Emphatics						Gutturals			
Pharyngealised			Uvular			Pharyngeal		Laryngeal	
tˤ	ðˤ	sˤ	q	χ	ʁ	ħ	ʕ	h	ʔ
Voiceless dental emphatic stop	Voiced inter-dental emphatic fricative	Voiceless alveolar emphatic fricative	Voiceless uvular stop	Voiceless uvular fricative	Voiced uvular fricative	Voiceless pharyngeal fricative	Voiced pharyngeal fricative	Voiceless laryngeal fricative	Voiceless laryngeal stop

[33] Following Watson (2002) in which she states that emphatics include segments that cause emphasis spread, in this dialect HA, the class includes Pharyngealised and uvular segments.

However, the emphasis spread feature is not restricted to the *pharyngealised coronals*, it also a feature that distinguishes uvular segments, as the case in HA as illustrated in the table above. In some other dialects of Arabic, the pharyngeals /ħ, ʕ/ have been reported as having a similar lowering effect as well[34] (Paddock, 1970; Watson, 2002).

Although emphatic segments are produced with more effort 'forceful' segments. They are retracted / back of the vocal tract with different points of articulation, they, however, create a constriction in the upper pharynx region. There is no consensus in the literature on the feature of emphasis, therefore, for the phonological analysis of the HA data regarding pharyngealisation and uvularisation I will refer to their effect as emphasis effect and represent it with the feature [RTR].

The phonetic dispute over the secondary articulation of the pharyngealised emphatics has led to adversity of terms proposed referring to the emphasis triggered by such segments in Arabic, i.e. /tˤ, ðˤ, sˤ/ (Al-Solami, 2013). In general, both pharyngealised and uvular segments are articulated with the tongue dorsum. However, the pharyngealised segments are articulated with the body of the tongue being "*more depressed*". Whereas the uvular segments are articulated with the dorsum of the tongue is "*retracted*" further (Gazeli, 1977; Al-Solami, 2013 p. 316). However, Bellem (2007) states that Arabic dialects differ in their representations of emphatics and this is what led the previous studies especially those that involve articulatory properties of emphatics to suggest other confusing terms to represent the phenomenon of emphatics.

The articulatory correlate of the pharyngealised and uvular segments from several studies in literature vary regarding the nature of the actual nature of the secondary articulation (Al-Ani, 1970; Ali & Danilofff, 1972; Gianni & Pettorino,1982; [35] Watson, 2002; Trubetzkoy, 1969; McCarthy, 1994;

[34] Given that these sounds are phonologically accredited in a given dialect (Watson, 2002 p. 270).
[35] In Iraqi Arabic.

Zawaydeh, 1999). However, it appears plausible that the retracted back of the tongue is the main articulator, which is referred to as [RTB] feature in some studies such as (Ali & Danilofff, 1972; Catford, 1977; Zawaydeh, 1999). Whereas the retracted tongue root which is referred to as [RTR] feature is a resultant of the movement of the body of the tongue further back in the vocal tract. This means that the root of the tongue is a dependent articulator correlate for the pharyngealised and uvular segments as opposed to the [RTB] being an independent and the main articulator correlate for the pharyngeal segments in Arabic (Al-Ani, 1970; Al-Solami, 2013).

By proposing the feature [pharyngeal], McCarthy (1994), groups the segments: pharyngealised, uvulars, pharyngeals and laryngeal in one natural class "*Gutturals*" and their common acoustic cue is a high F_1. It is not, however, the primary acoustic correlate for the emphasis induced by the pharyngealised and uvular segments, which in this case is the low F_2.

4.2.1 Pharyngealised and uvular segments in HA:

Emphatics are segments that involve "*a constriction in the upper pharynx which triggers the raising of the tongue towards the roof of the mouth*" (Ghazeli, 1977 p. 55). They exhibit coarticulation a coronal primary articulation and a secondary articulation where the back of the tongue is retracted to "*back wall of the pharynx at the level of the second cervical vertebrate*" (Ghazeli, 1977 p. 55). The emphatics /tˤ, dˤ, sˤ, ðˤ, zˤ/ are the most common emphatic segments in different dialects of Arabic. /sˤ/ and /tˤ/ are found in every dialects of Arabic while other dialects have /dˤ/ ~ [ðˤ] or /ðˤ/ ~ [zˤ]. Three emphatic segments are found in HA /sˤ, ðˤ, tˤ/ [sˤɑnˤnˤ] 'stinky', [ðˤɑnˤnˤ] 'doubt' and [tˤɑnˤnˤ] 'ton'. Whereas /dˤ/ does not exist in HA and any instances that include /dˤ/ will automatically be substituted by /ðˤ/ such as /dˤɑːbˤɨtˤ/ → [ðˤɑːbˤɨtˤ] 'officer'.

The Arabic uvular segments are the voiced fricative /ʁ/, the voiceless fricative /χ/ and the voiceless stop /q/. Uvular sounds are produced when the dorsum of the tongue is retracted then raised closer to the uvula, which results in a constriction (Catford, 1977; Ghazali, 1977). The presence of the three uvular segments /q, χ, ʁ/ varies in different dialects of Arabic. Some dialects retain all three uvulars while some dialects substitute /q/ ~ [g], /q/ ~ [ʔ] or [k] Palestenian Arabic, and /q/ ~ [g] or [ʤ] Kuwaiti Arabic. The uvular /ʁ/ ~ [q] Kuwaiti Arabic, Qatari Arabic, Bahraini Arabic and in eastern region of Saudi Arabia, hence HA. More about substitution and alternation is discussed in chapter five. HA also shows, in some specific examples, the appearance of the allophonic [ɢ].

4.2.1.1 Status of /q/ in HA

Some scholars suggest that /q/ is the emphatic counterpart of /k/ such as (Khan, 1976), others suggest that /q/ has an emphasis effect that spreads throughout the entire word (Woidich, 1999). However, Watson (2002) and Owen (2013) argue that the emphasis spread from /q/ is as limited as reaching to the adjacent vowel, and have an emphasis affect. In the absence of emphatic segments, Bellem, (2007 p. 190) also claims that certain strings of or combination of segments are triggers of emphasis. These segment combinations are: the uvulars /χ, ʁ/ with the liquids /r, l/ and labials; the velar /g/ with the liquids /r, l/ and labials in the vicinity of the vowels /ɑ, u/ (Bellem, 2007). Al-Wer and Horesh (2019) report the substitution of /q/ to [g] in the Gulf dialects and particularly in Saudi Arabia. /q/ has the following variants: /q, g, ʤ, ʣ/ (Al-Wer & Herin, 2011, p. 62; Shosted *et. al* 2017)[36]. The occurrence of /q/ in Arabic dialects often referred/ related to the religious and formal nature of the words containing /q/ sound. However, this claim is opposed by Al-Hawamdeh and Hamed (2017) where the existence of the /q/ in the Ammani dialect

[36] However, /q/ as the underlying representation of the surface [g] is controversial amongst scholars.

caused by different social factors such as social networks and family dialect (Al-Hawamdeh and Hamed, 2017 p.76).

However, the HA data reported in this study prove the phonemic status of /q/ in the dialect as it is still an active phoneme in HA: [qʉħ] ‘original’, [qɑnʧa] ‘serving dish’ [qiːfa] ‘ugly’. Although there are examples that exhibit substitution of /q/ →[g] in HA: [gilːl] ‘little’, [giʃir] ‘peel’, [gidir] ‘pot’, /q/ is not totally substituted with /g/ in the dialect.

4.2.1.2 Status of /χ/ and /ʁ/ in HA

The place of articulation of the voiceless uvular fricative /χ/ is more fronted than the voiced uvular fricative /ʁ/. During the articulation of /χ/ the tongue is flatter and produced with more constriction in the upper pharynx. While the point of articulation of /ʁ/ is further back than /χ/ and the tongue is curled and produced with less constriction in the upper pharynx. The following segments are ordered in the sense of their point of articulation from front to back: /ðˤ/- /tˤ/- /sˤ/- /q/- /χ/- /ʁ/ (Zawaydeh, 1999).

4.2.1.3 Status of /ɢ/ and /g/ in HA

The velar /g/ is a salient consonant in HA both as a phonemic as well as an allophonic to the uvular /q/ in certain environments such as /qɑliːl/ → [gilːl] ‘little’. Its occurrence is also eminent in many loanwords in HA according to Smeaton (1973). In addition, in some lexical items from the Gulf Arabic dialects /g/ surfaces as the affricate variants [ʤ] or [ʣ][37] in the vicinity of front vowels (Johnston,1978; Mustafawi, 2006, 2007; Shosted *et. al* 2017). The examples in (4-3. a) are adopted from Qatari Arabic Mustafawi (2006 p. 72) and the examples in (4-3.b) are from HA, my own data:

[37] Whereas /k/ surfaces as the affricate variants [ʧ] or [ʦ]. Although the affrication phenomenon is salient in HA, it is, however, beyond the scope of this research.

Example 4-3 Status of /ɢ/ and /g/ in HA

	Input		Output	Gloss
a.	/giriːb/	→	[ʤiriːb]	‘nearby’
	/kibiːr/	→	[ʧibiːr]	‘big / large’
	/rigiːg/	→	[riʤiːʤ]	‘thin’
b.	/giblah/	→	[ʤiblah] / [ʤiblah]	‘west’
	/riglah/	→	[riglah] / [riʤlah]	hisitant’
	/migbil/	→	[miʤbil] / [miʤbil]	‘forthcoming’
	/giliːb/	→	[ʤiliːb] / [ʤiliːb]	‘well’

However, in other examples /g/ appears to have an emphasis effect in which case it triggers the occurrence of the pharyngealised lateral /lˤ/. Although /g/ is a dorsal segment, it, however, does not have the feature [pharyngeal]. As a result, it cannot spread an emphasis effect or trigger the appearance of a pharyngealised allophone like /lˤ/. I assume the source of emphasis in such case would be the adjacency to a pharyngealised segment /tˤ/, /ðˤ/ and /sˤ/or a pharyngealised vowel /ɑ/, /ʉ/ and /ɨ/. Nevertheless, the voiced uvular stop /ɢ/, on the other hand, triggers emphasis since it has the feature [pharyngeal].[38] The examples in (4-4) below show the emphasis effect triggered by /ɢ/. The status of /g/ and /ɢ/ is discussed further in chapter five.

Example 4-4 emphasis effect triggered by /ɢ/ in HA

	Input		Output	Gloss
a.	/ɢalb/	→	[ɢɑlˤbˤ]	‘heart’
	/ɢiful/	→	[ɢɨfˤʉlˤ]	‘lock’

[38] The status of /ɢ/ in HA is discussed more in chapter 5.

The following section investigates the extent to which the emphasis spreads from pharyngealised and uvular segments in HA, i.e. what the domain is of the spread of emphasis is: with in a syllable, the whole word, beyond word boundaries or confined to merely adjacent vowels to the trigger of emphasis the pharyngealised /tˤ, ðˤ, sˤ/ and the uvular segments /χ, ʁ, q, ɢ/? In addition, an acoustic evidence will be provided to account for the domain of emphasis spread in HA at different levels.

4.3 Domain of emphasis spread in HA

Emphasis that spreads within the syllable covering both consonants and vowels, that includes the primary emphatic sound, on one hand, is a characteristic of the "*Central Semitic languages*" (Watson, 2002 p. 268). On the other hand, Arabic has the characteristic where the emphasis spreads not only within the syllable, but also through the whole word in general (Watson, 2002).

The pharyngealised segments in MSA, show with some variations in differing dialects of Arabic, that other sounds become pharyngealised due to the emphasis spread effect triggered by the adjacency to the pharyngealised segments /tˤ, dˤ, ðˤ, sˤ/, the uvulars /χ, ʁ, q/ and the velar /g/ over the adjacent segments: vowels and consonants in the same syllable or even over the entire word (Embarki et. al., 2007; Alosh, 1987; and Elshafei, 1991; Davis, 1995).[39]

Bellem (2007), Habib (2012) and Owen (2013) all share the same assumption that emphasis spread is prosody rather than segmental that happens minimally in a CV domain, i.e. it occurs in a higher level of the prosodic hierarchy 'syllable' not in a lower level in the 'segments' as in consonants and vowels. During the pronunciation of the emphatic consonant and its surrounding vowels, the same articulatory process persists that involve RTB and this is a proof that the emphasis is a prosodic not a segmental process (Bellem, 2007; Habib, 2012; Owen, 2013).

[39] These studies assume the velar /g/ as a source of emphasis.

Furthermore, Jongman, et al. (2011), found that in the vicinity of the pharyngealised segments /dˤ, tˤ, sˤ, ðˤ/, not only the adjacent vowel is affected; the emphasis effect extends to the other consonant in the same syllable of a CVC sequence of a monosyllabic word. Whether the pharyngealised segment, the trigger of emphasis, is in the onset position or in the coda position the affected segments exhibit the emphasis spread through a lower spectral mean. The plain fricatives /s, ð/, however, do not trigger an emphasis effect through no change in the spectral mean (Jongman, 2011).

In spite of that, some studies report dialects which exhibit different behaviour in terms of the emphasis spread and the degree of the vowel backness, to mention a few: the pharyngealisation only extends minimally to the adjacent vowels in Abha dialect of Saudi Arabia (Watson, 1999); the emphasis spread was not the same for each dialect that Bellem (2007) investigates, Damascene Arabic, Muslim Baghdadi Arabic and Christian Baghdadi Arabic, this means that generalising the emphasis spread mechanism for all Arabic dialects without a proper data from all the Arabic dialects is not appropriate (Bellem, 2007); The measurements of F_1 and F_2 in the different studies show a dispersion of the vowels in the pharyngealisation environments which can attribute to the variation in the pharyngealisation in Arabic (Embarki, 2017).

4.3.1 Emphasis spread at word level

In order to examine the extent of the emphasis spread at the word level of the segments under investigation, examples of monosyllabic, disyllabic and polysyllabic words are provided below from HA which exhibit a spreading pattern regarding the domain of emphasis as shown in the examples in (4-5) below.

Example 4-5 Emphasis spread at word level in HA with pharyngealised segments

	lexical level	Input	Output	Gloss
a.	Monosyllabic	/ʕasˤ/	[ʕˤɑsˤ]	‘hard’
		/tˤaːr/	[tˤɑːrˤ]	‘drum’
		/lafðˤ/	[lˤɑfðˤ]	‘pronunciation’
		/ðaːʕ/	[ðˤɑːʕ]	‘lost’
b.	Disyllabic	/ðˤa.laːm/	[ðˤɑ.lˤɑːmˤ]	‘darkness’
		/miħ.maːsˤ/	[mɨħ.mˤɑːsˤ]	‘pan’
		/ba.laːtˤ/	[bˤ.lˤɑːtˤ]	‘tiles’
		/tˤuː.ba/	[tˤʉː.bˤɑ]	‘brick’
c.	Polysyllabic	/mar.ma.tˤa/	[mˤɑrˤ.mˤɑ.tˤɑ]	‘problematic’
		/tˤaːr.bi.ga/	[tˤɑːrˤ.bˤɨ.gɑ]	‘crumbling’
		/mur.ðˤi.ʕa/	[mˤʉrˤ.ðˤɨ.ʕa]	‘wet nurse’
		/sˤuː.ma.ʕa/	[sˤuː.ma.ʕa]	‘room’

The emphasis triggered by the pharyngealised segments in HA /tˤ, ðˤ, sˤ/ spreads in both directions covering the entire word as shown in the in the examples in (4-5) above. The word level can be a monosyllabic word where the pharyngealised segment occurs in the coda as in [ʕɑsˤ] or in the onset as in [ðˤɑːʕ] allowing the emphasis to spread from left to right in the former and right to left in the latter. In the disyllabic examples, the pharyngealised /tˤ/ in the word [bˤ.lˤɑːtˤ] occurs in a word-final position, the coda, allowing the emphasis to spread leftward across two syllables. Whereas in the word [tˤʉː.bˤɑ], this time /tˤ/ occurs word-initially causing the emphasis to spread rightward. On the other hand, the example [mˤʉrˤ.ðˤɨ.ʕa] is a polysyllabic word in which the emphasis from /ðˤ/ spreads in both direction leftward and rightward covering the entire word.

On the other hand, following (Jacobson (1957), Garbell (1958) and Watson (2002), amongst others, I classify the uvular segments in HA as emphatics where they have an emphasis that spreads to adjacent segments. The uvular emphasis is arguably weak and limited in terms of spread domain in the attested Arabic dialects such as Cairene and San'ani (Watson, 2002).

The following examples in (4-6) show the extent of the emphasis spread that triggered by the uvular segments /χ, ʁ, q, ɢ/ in HA. Their emphasis spreads throughout the entire word irrespective of its level, i.e. whether it is a monosyllabic word, a disyllabic word or a polysyllabic word if the segments /χ, ʁ, q/ and /ɢ/ occur as in [ʁɑrˤ.bˤɑ.lˤɑ] word-initially in the onset position. Whereas if /χ, ʁ, q/ and /ɢ/ occur word-medially, the spread would then be limited to the following segments as in the case of [na.χɑlˤ]. However, it is apparent from the examples that /χ, ʁ, q/ and /ɢ/ spread their emphasis progressively from left to right in one direction only where the segments spread their emphasis on the following segments and beyond to the end of the word.

On the other hand, the following section 4.3.2. provides further information on the complex nature of polysyllabic words with prefixes and suffixes, i.e. across morphemic boundaries and the extent of the emphasis spread in the vicinity of both pharyngealised and uvular segments in HA.

Example 4-6 Emphasis spread at word level in HA with uvular segments

	lexical level	**Input**	**Output**	**Gloss**
a.	Monosyllabic	/χam/	[χɑmˤ]	'vacuum'
		/ʁaːb/	[qɑːbˤ]	'disappear'
		/ʁaʃ/	[qɑʃˤ]	'cheat'
		/qal/	[qɑl]	'little'

		/ɢɑm/	[ɢɑmˤ][40]	‘rise’
b.	Disyllabic	/χa.laːl/	[χɑ.lˤɑːlˤ]	‘dates’
		/χa.laɢ/	[χɑ.lˤɑɢ]	‘create’
		/na.χal/	[nˤɑ.χɑlˤ]	‘palmtrees’
		/ʁa.mar/	[qɑ.mˤɑrˤ]	‘fill’
		/la.ʁam/	[la.qɑmˤ]	‘mine’
		/ɢɑ.lam/	[ɢɑ.lˤɑmˤ]	‘pen’
		/qa.laq/	[qɑ.laq]	‘worry’
		/ma.qar/	[mˤɑ.qɑrˤ]	‘headquarters’
		/ɢa.laʕ/	[ɢɑ.lˤɑʕ]	‘rip’
		/ʃi.ɢal/	[ʃɨ.ɢɑlˤ]	‘lift’
c.	Polysyllabic	/χaz.bi.ɢa/	[χɑz.bˤɨɢɑ]	‘storm’
		/ʁar.ba.la/	[qɑrˤ.bˤɑ.lˤɑ]	‘trouble’
		/ʁa.maː.ra/	[qɑ.mˤɑː.rˤɑ]	‘backseat’
		/ħa.la.qa/	[ħa.lɑ.qɑ]	‘ring’
		/ʁa.man.da/	[qɑ.mɑnˤ.da]	‘gist’
		/ɢa.ram.baʕ/	[ɢɑ.rˤɑmˤ.bˤɑʕˤ]	‘rusty’

4.3.2 Emphasis spread across morphemic boundaries

To discover the extent of the emphasis domain in HA, it is important to investigate the spread of emphasis triggered by the pharyngealised as well as the uvular segments at the morphological level. The emphasis triggered by the pharyngealised segments /tˤ, dˤ, ðˤ, sˤ/ spreads across the morphemic boundaries: prefixes

[40] The velar /g/ under emphasis spread effect from the adjacent vowels /ɑ, ɨ, ʉ/ surfaces as [ɢ]

and suffixes is attested in some Arabic dialects such as 9abady Arabic, Syrian Arabic, and Kuwaiti Arabic (Sakarna, 1999 p. 124; Adra, 1999 p.180; Aldaihani, 2014 p. 157) respectively. Whereas other dialects, including Makkan Arabic, restricts spreading of pharyngealisation to the root and suffixes (Kabrah, 2004). Some other studies report optionality when it comes to the spreading of emphasis. In Cairene and Palestinian Arabic, for example, emphasis is optionally blocked from the prefixes (Younes, 1994) while in Jordanian the emphasis is optionally blocked from the suffixes (Zawaydeh, 1997).

An investigation is conducted on the effect of morphemic boundaries on the spreading emphasis of the pharyngealised segments /tˤ, ðˤ, sˤ/ in HA and the results are presented in the following examples in (4-7). The morphological boundaries of the pharyngealised segments have no restrictions on the emphasis spreading in HA. As a result, the emphasis effect is not limited to the root of the word alone but spreads bidirectionally covering the entire complex word including the prefixes and suffixes.

Example 4-7 Emphasis spread to prefixes and suffixes from pharyngealised segments in HA.

Morphemic boundary	**Input**	**Output**	**Gloss**
prefix	/ʔa+tˤarrib/	[ʔˤɑ+tˤɑrˤrˤɨbˤ]	‘anounce’
	/na+sˤbir/	[nˤɑ+sˤbˤɨrˤ]	‘wait’
	/ja+ðˤmir/	[jˤɑ+ðˤmˤɨrˤ]	‘cover’
suffix	/tˤa:r+ik/	[tˤɑ:rˤ+ɨkˤ]	‘your drum’
	/ta:r+ha/	[tˤɑ:rˤ+hˤɑ]	‘her drum’
	/ta:r+na/	[tˤɑ:rˤ+nˤɑ]	‘our drum’

Similarly, the investigation into the emphasis triggered by the uvulars /χ, ʁ, q, ɢ/ reveals the same patterning of the emphasis triggered by the HA pharyngealised segments. Meaning the morphological

boundaries show no blocking effect of the emphasis extended regressively to the prefixed segments and progressively to the suffixed segments as seen in the following examples in (4-8).

Example 4-8 Emphasis spread to prefixes and suffixes from uvulars in HA

Morphemic boundary	Input	Output	Gloss
prefix	/ja+χlug/	[jˤɑ+χlˤʊɢ]	'he creates'
	/na+ʁmur/	[nˤɑ+ʁmˤʊrˤ]	'we fill'
	/ʔa+qassam/	[ʔa+qɑrssam]	'I devide'
	/ʔa+ɢlaʕ/	[ʔˤɑ+ɢlˤɑʕˤ]	'I uproot'
suffix	/χalaɣ+ik/	[χɑlˤɑɢ+ikˤ]	'he creates you'
	/ʁamar+hum/	[ʁɑmˤɑrˤ+ hˤʊmˤ][41]	'he filled them'
	/qassam+na/	[qɑssam+na]	'we devided'
	/ɢalaʕ+hum/	[ɢɑlˤɑʕˤ+hˤʊmˤ]	'uproots them'

From the examples given in (4-7) and (4-8) above, it is apparent that morphological boundaries do not restrict the spreading emphasis of the pharyngealised and uvular segments to the entire complex word in HA.

An acoustic evidence is provided below confirming the emphasis spread of the pharyngealised segmets /tˤ, ðˤ, sˤ/ in HA surpasses the stem to cover the segments in the prefix and the suffix. The data in Table 4-2 confirm acoustically that the pharyngealised /tˤ/ spreads the emphasis throughout the entire word as well as across the morphemic boundaries to the prefix /ʔa-/ → [ʔˤɑ-]. This pharyngealisation spread is

[41] The examples [nˤɑ+ʁmˤʊrˤ] and [ʁɑmˤɑrˤ+ hˤʊmˤ] are presented here to show the emphasis spread triggered by the uvular segment /ʁ/ in HA. However, the final output forms would be [nˤɑ+qmˤʊrˤ] and [qɑmˤɑrˤ+ hˤʊmˤ] as a result of alternation from /ʁ/ to [q] in HA. The alternation between the uvulars /ʁ/ and /q/ is discussed in chapter 5.

manifested in the low F_2 of the vowel /ɑ/ in the prefix [ʔˤɑ-] preceding the stem [rˤɑtˤtˤɨbˤ]. Whereas the minimal pair with the counterpart /t/ shows no emphasis spread [ʔa-rattib] with a higher F2 reading at (2068 Hz). The significant drop of F2 in the prefix vowel from (2068 Hz) → (1374 Hz) with the difference at 694 is crucial evidence of the emphasis spread of the pharyngealised /tˤ/ across the morphemic boundaries to the prefix in HA.

Table 4-2: Acoustics of emphasis spread of pharyngealised to prefix and suffix in HA

Morphologic boundary	Pharyngealised segments	Examples	Gloss	F2 in Hz	Difference
Prefix	/tˤ/	ʔˤɑ+rˤɑtˤtˤɨbˤ	'to wet'	1374	694
	/t/	ʔa+rattib	'to arrange'	2068	
Suffix	/sˤ/	sˤʉːr+ɨkˤ	'your horn'	1166	592
	/s/	suːr+ik	'your fence'	1758	

Similarly, the emphasis of the pharyngealised /sˤ/ spreads progressively across the morphemic boundaries which is manifested in the low F2 of the vowel /i/ measuring at (671 Hz) in the suffix /-ik/→ [-ɨkˤ] following the stem [sˤʉːrˤ]. While the minimal pair with the counterpart /s/ in [suːr-ik] shows no emphasis spread with a higher F2 measuring at (1758 Hz), a noteworthy drop of the F2 in the suffix vowel which brings difference between the measurements of F2 in the minimal pairs to 592 Hz. Although the lowering of F2 of /ɨ/ in the in the vicinity of the pharyngealised /sˤ/ is not as significant as that of the prefix example. Yet, it is crucial evidence of the progressive pharyngealised emphasis spread to the suffix in HA.

Correspondingly, the uvulars /χ, ʁ, ɢ, ɢ/ exhibit a similar emphasis spread across morphemic boundaries. The data presented in Table 4-3 provide an acoustic evidence of the emphasis effect of the

uvular /χ/ that spreads across the word stem [χɑbˁbˁɨrˁ] as well as regressively reaching the prefix in [ʔˁɑ-]. The example [ʔˁɑ-χɑbˁbˁɨrˁ] shows a significant low F2 of the prefix vowel /ɑ/ measuring at (1106 Hz). Likewise, the emphasis of the uvular /χ/ in HA show an emphasis spread non only bidirectional emphasis spread to cover the word stem [bˁʉχʉːrˁ], but surpasses that progressively reaching the suffix [-ɨkˁ]. The example also shows substantial low F2 in the suffix vowel /ɨ/ measuring at (965 Hz). These low F2 readings of the vowels in the prefix [ʔˁɑ-] and suffix [-ɨkˁ] confirm acoustically that the domain of the emphasis spread of the uvulars in HA is the entire complex word. The same emphasis spread is reported acoustically by the uvular /ɢ/ in HA where it patterns with the both the pharyngealised and the other uvular segments in this matter.

Table 4-3: Acoustics of emphasis of uvulars spread to prefix and suffix in HA

Morphologic boundary	**Pharyngealised segments**	**Examples**	**Gloss**	**F2 in Hz**	**F1 in Hz**	**F1-F2**
Prefix	/χ/	ʔˁɑ+χɑbˁbˁɨrˁ	'to tell'	1106	812	294
Suffix	/χ/	buχʉːr+ɨkˁ	'your scent	965	540	425

As a result, on the word level, the domain of emphasis spread of the pharyngealised /tˁ, ðˁ, sˁ/ and the uvular /χ, ʁ, q, ɢ/ segments in HA is the stem of the word as well as it spreads regressively to the prefix and progressively to the suffix. Therefore, the morphemic boundaries have no effect in blocking the spread of the emphasis in HA as proven acoustically. The following section presents the emphasis spread triggered by the pharyngealised and uvular segments in HA at a post-lexical level, i.e. across word boundaries. pread will occur.

4.3.3 Emphasis spread at post-lexical level

This section investigates the pharyngealisation and uvularisation spread in HA at a post-lexical level. The spread of pharyngealisation, .i.e. the emphasis triggered by /tˤ, ðˤ, sˤ/ at post-lexical level is conditioned by having the plain counterpart segments in the coda of the preceding word. , i.e. the pharyngealised triggers /tˤ, ðˤ, sˤ/ in a given onset in HA will only spread their emphasis to their plain counterparts /t, ð, s/ in the coda of the preceding word of a phrase. However, if the coda of the preceding word is a segment other than these plain counterpart segments, then no emphasis spread will occur. The examples in 4-9 exhibit this notion. This patterns with some literature studies which report a further regressive emphasis spread in some Arabic dialects such as Qatari Arabic, Syrian Arabic and Kuwaiti Arabic, triggered by the pharyngealised segments /tˤ, dˤ, zˤ, ðˤ, sˤ/ at a phrasal level in which the emphasis spreads across word boundaries.[42], i.e. regressively at the phrasal level (Alsulaiti, 1993; Adra, 1999; Aldahani, 2014). The HA examples are presented in 4-9 below.

Example 4-9 Post-lexical emphasis spread by pharyngealised segments in HA

	Input	**Output**	**Gloss**
a.	/ʃaːbbat # tˤibiːnah/	[ʃaːbbatˤ # tˤɨbˤɨːnˤɑ]	‘she started a fire’
b.	/nuwaːfið # ðˤaːkka/	[nuwaːfiðˤ # ðˤɑːˤkˤkˤɑ]	‘narrow windows’
c.	/ħaːris # sˤaːħi/	[ħaːrisˤ # sˤɑːħˤɨ]	‘alerted guard’
d.	/ʃam # tˤiːb/	[ʃam # tˤɨːbˤ]	‘he smelled a perfume’
e.	/ʔakal # ðˤifra/	[ʔakal # ðˤɨfˤrˤɑ]	‘he ate his nail’
f.	/limaħ # sˤuːra/	[limaħ # sˤʉːrˤɑ]	‘he saw a picture’

[42] The symbol # denotes the word boundaries.

The examples in (4-9) show that the same conditions apply in HA. In order for the post-lexical emphasis spread to occur in HA, the onset of the second word must be one of the pharyngealised segments /tˤ, ðˤ, sˤ/ whereas the coda of the first word must be a plain counterpart /t, ð, s/. In other words, the emphasis of the pharyngealised segments spreads to the plain counterpart segments in the coda position of the first word in the phrasal level, but the emphasis is blocked to the others segments. In a post lexical level, no emphasis spread surpasses the coda of a preceding word.

If, however, the pharyngealised segments occur word-medially, i.e. in a second syllable for example, then the emphasis is blocked from spreading regressively across the boundaries of the second word and it would only be confined to the first word. As the examples in (4-10) show that in HA, the position of the pharyngealised segments also play an important role in terms of spreading the emphasis regressively across the word boundary. The emphasis of the pharyngealised segments /tˤ, ðˤ, sˤ/ across the word boundary is blocked when they occur word-medially.

Example 4-10 No post-lexical emphasis to non- counterparts in HA

	Input	**Output**	**Gloss**
a.	/naʕat # matˤnuːχ/	[naʕat # mˤɑtˤnˤʉːχ]	‘I qualified a rich man’
b.	/tilmiːð # maħðˤuːðˤ/	[tilmiːð # mˤɑħˤðˤʉːðˤ]	‘a lucky student’
c.	/kaːs # masˤbuːb/	[kaːs # mˤɑsˤbˤʉːbˤ]	‘a poured cup’

The pharyngealised /tˤ/ occurs word-medially in the coda of the first syllable of the second word of the phrase in (4-10. a). Although it spreads its emphasis bidirectionally throughout the second word [mˤɑtˤnˤʉːχ], its emphasis is blocked from spreading regressively across the word boundary reaching the counterpart /t/ in the coda of the first word. Similarly, in (4-10. b and c) /ðˤ/ and /sˤ/ fail to spread the

emphasis regressively to their counterparts /ð/ in [tilmiːð] and /s/ [kaːs] in the coda of the first word of the phrase.

On the other hand, Aldaihani (2014 p.155) reports that the emphasis triggered by the pharyngealised segments /tˤ, ðˤ, sˤ/ is restricted progressively across the word boundary in KA. Consistently, the progressive emphasis spreading of the pharyngealised /tˤ, ðˤ, sˤ/ segments is not attested across word boundary in HA. The examples in (4-11) demonstrate that the target of this progressive emphasis spread from the pharyngealised segments /tˤ, ðˤ, sˤ/ at the post-lexical level from the coda of the preceding word of the phrase is blocked even to the plain counterparts /t, ð, s/ in the onset position of the second word.

Example 4-11 blocked progressive post-lexical emphasis in KA and HA

	Dialect	Input	Output	Gloss
a.	**KA**	/ħaːtˤ # taiʤ/	[ħɑːtˤ # taiʤ]	‘he puts a crown on his head’
b.		/qorsˤ # saːχin/	[qoˤrˤsˤ # saːχin]	‘a hot disk’
c.		/ʕaðˤ # ðeːlaː/	[ʕˤɑðˤ # ðeːlaː]	‘it bit its tail’
d.	**HA**	/ʔaħitˤ # tamir/	[ʔˤɑħɨtˤ # tamir]	‘I put dates’
e.		/ʔabiːðˤ # ðahab/	[ʔˤbˤɨːðˤ # ðahab]	‘I lay eggs’
f.		/faħsˤ # saliːm/	[fˤɑħˤsˤ # saliːm]	‘intact examination’

Nevertheless, the uvulars /χ, ʁ, q, ɢ/ segments have a limited emphasis spread in terms of the level in HA. They neither trigger a regressive post-lexical emphasis spread across word boundary nor do they trigger a progressive post-lexical emphasis spread either. Although their emphasis spreads bidirectionally throughout the word, the examples in (4-12) show that their emphasis spread is blocked beyond the word boundary in HA.

Example 4-12 blocked post-lexical emphasis spread from uvulars in HA

	Spread direction	Input	Output	Gloss
a.	**Regressive**	/zaχ # ʃamma/	[zˤɑχ # ʃamma]	‘he took Shamma’
b.		/farraʁ # sajjaːrta/	[fˤɑrˤrˤɑq # sajjarta]	‘he emptied his car’
c.		/waθθaq # tasliːma/	[wˤɑθˤθˤɑq # tasliːma]	‘he documented his submission’
d.		/ħaraɢ # beːta/	[ħˤɑrˤɑɢ # beːta]	‘he burnt his house’
e.	**Progressive**	/mattar # ʁurfiti/	[mattar # qʊrˤfˤɪtˤɨ]	‘he measured my room’
f.		/killiʃ # χabal/	[killiʃ # χɑbˤɑlˤ]	‘very crazy’
g.		/sakkarat # qanaːta/	[sakkarat # qɑnˤɑːta]	‘his channel closed’
h.		/kisab # ɢɑlbi/	[kisab # ɢɑlˤbˤɨ]	‘he won my heart’

However, the uvular /q/ exhibits a different case of a limited emphasis spread in the examples here. As mentioned earlier. /q/ in HA has a limited emphasis spread to adjacent vowels as does in many other dialects of Arabic. Although /q/ has a minimal spread of its emphasis to the adjacent vowels /a/ causing it to become the further back [ɑ] as shown in (4-12. c) /qanaːta/ → [qɑnˤɑːta] though /q/ does not trigger a further emphasis spread across word boundaries. Still, it is worth mentioning that /q/ exhibits emphasis spread further than the adjacent vowel in a limited number of words, although rare, yet attested in the dialect.[43]

[43] [ʃˤʊrˤʊːq] ‘sunrise’, [tɑwθiːq] ‘authentication’ these words are other examples of /q/ emphasis effect in HA.

While the uvular /χ, ʁ, q, ɢ/ segments do not spread emphasis across word boundary in HA as seen in the examples in (4-12) above, some phonological processes however do occur between these segments regressively across word boundary. This is demonstrated in the examples in (4-13) below.

Example 4-13 Alternation between uvulars in HA

	Input	**Output**	**Gloss**
a.	ʃmaːʁ # χalaf	[ʃˤmˤɑːχ # χɑlˤɑfˤ]	‘Khalaf’s headdress’
b.	/salχ # ʁaːliː/	[sˤɑlˤʁ # ʁɑːlˤɨː]	‘very expensive’
c.	[ʔinzilaːq # ʁuðˤruːfi]	[ʔinzilaːq # qʉðˤrˤʉːfˤɨ]	‘herniated disc’
d.	/zaːʁ # ɢɑlbi/	[zˤɑːɢ # ɢɑlˤbˤɨ]	‘deflected my heart’

The examples presented in (4-13) incur more complicated processes including the alternation between uvular segments that apply within intermediate derivational steps. The discussion of such examples is left for the next chapter, chapter five which addresses the uvular alternation phenomenon in HA.

As a result, the emphasis spreads from the pharyngealised segments in HA is restricted across word boundary. It occurs regressively if and only if the onset of the second word of the phrase is one of the pharyngealised segments /tˤ, ðˤ, sˤ/ while the coda of the first word is the plain counterpart /t, ð, s/. if these conditions are not satisfied, then the regressive emphasis spread is blocked. Any other segment in the dialect is not a target to this emphasis spread. Emphasis does not spread progressively across word boundaries in HA. This coincides with what has been reported about the regressive nature of the emphasis spread and as being an assimilation process in Arabic in most modern dialects (Ferguson, 1956). Although the uvulars have similar emphasis spread pattern to the pharyngealised segments in HA, they however, are limited in terms of spreading their emphasis across word boundary.

This section has illustrated the domain of emphasis spread from the pharyngealised and the uvular segments in HA illustrate that the word stem is the domain of emphasis spread whether it is a mono, disyllabic, or polysyllabic word. In addition, the emphasis extends across the morphemic boundaries regressively to reach the prefix and progressively reaching the suffix. As to the post lexical level, across the word boundary, the emphasis spreading is limited to being the effect triggered by the pharyngealised segments which spreads regressively reaching the coda of the first word of the phrase and not further. The following section, On the other hand, investigates the directionality of the emphasis spread triggered by the pharyngealised and uvular segments in HA on the lexical level.

4.4 Direction of emphasis spread in HA

This section presents the directions of emphasis spread in HA. Whether the emphasis is triggered by the pharyngealised or the uvular segments, the directions are consistent. Three directions in which the emphasis of the pharyngealised segments could spread as stated in many literature studies of different modern dialects of Arabic, i.e. regressive: in which the emphasis spreads leftward; progressive: in which the emphasis spreads rightward; and bidirectional: in which the emphasis spreads in both directions regressively and progressively from the source of emphasis being word-medially (Embarki et. al., 2007; Alosh, 1987; and Elshafei, 1991; Davis, 1995). Ferguson (1956) suggests that while the pharyngealised segments /sˤ, dˤ, tˤ, ðˤ/ trigger the appearance of other pharyngealised ones such as /lˤ/ by spreading their emphasis regressively and progressively, the uvular segments /χ, ʁ, q, ɢ/ on the other hand, only have a progressive emphasis spread direction where they trigger appearance of other pharyngealised ones such as /lˤ/ only after the uvulars, but never before them.

In literature, some studies denote that the direction in which the pharyngealisation effect spreads varies in the dialects of Arabic. Some dialects allow regressive spread, others allow progressive spread,

and some allow bidirectional spreading regressive and progressive (Watson, 1999, 2002; Bellem, 2007). Davis (1995) argues that in Saudi Arabic, the direction of emphasis spread is normally regressive and spreads from the pharyngealised segments leftward "*to the beginning of the word*" (p. 494). Whereas other researchers argue that, in Saudi Arabic the emphasis spreads regressively and progressively Jongman, et al. (2011).

Consistently, the pharyngealised segments in HA show a similar effect in terms of the types of directionality of emphasis spread. As shown in the examples in (4-14) below, HA patterns with the dialects mentioned above in the sense that the emphasis spreads regressively from the coda position all the way to the beginning of the word, i.e. right to left spread; the emphasis spreads progressively from the onset position to the end of the word; it also spreads bidirectionally to the left and right covering the whole word.

Example 4-14 Direction of emphasis spread in HA

	Direction	**Input**	**Output**	**Gloss**
a.	**Regressive**	/ʕabatˤ/	[ʕabˤatˤ]	'stupidity'
b.		/lafðˤ/	[lˤafˤðˤ]	'pronunciation'
c.		/ħariːsˤ/	[ħarˤɨːsˤ]	'keen'
d.	**Progressive**	/tˤaːr/	[tˤaːrˤ]	'drum'
e.		/ðˤaːʕ/	[ðˤaːʕˤ]	'lost'
f.		/sˤaːʤ/	[sˤaːʤˤ]	'grill'
g.	**Bidirectional**	/matˤ.juːr/	[mˤatˤ.ʉːrˤ]	'reckless'
h.		/mas.tˤuːl/	[mˤasˤ.tʉːlˤ]	'drunk'
i.		/maðˤ.muːn/	[mˤaðˤ.mˤʉːnˤ]	'guaranteed'

j.	/man.ðˤuːr/	[mˤɑnˤ.ðˤʉːrˤ]	‘perspective’
k.	/masˤ.duːm/	[mˤɑsˤ.dʉːmˤ]	‘shocked’
l.	/maf.sˤuːl/	[mˤɑfˤ.sˤʉːlˤ]	‘detached’

The examples in (4-14. a-c) show that the emphasis spreads regressively when the pharyngealised segment is located in a word-final position. Whereas the examples in (4-14. d-f) show that the emphasis spreads progressively when the pharyngealised segment is located in a word-initial position. Besides, the examples in (4-14. g-l) show that the emphasis spreads bidirectionally when the pharyngealised segment is located in a word-medial position. Although the examples (4-14. g-l) exhibit a bidirectional emphasis spread, deciding which direction the emphasis spreads first: from the source of emphasis word-medially going regressively or progressively. This is of significant importance to the analysis of HS-OT. Since every single change happens in a different derivational step. As a result, identifying the first spread direction is depends on the position of the source of the emphasis. Meaning, if the trigger of the emphasis is in the coda position of the first syllable as in (4-14. i) /maðˤ.muːn/, then the emphasis spreads regressively and gradually from /ðˤ/ to the adjacent segments in the same syllable /mˤɑðˤ.muːn/. After that, the emphasis spreads from /ðˤ/ progressively covering the adjacent segments in the next syllable gradually [mˤɑðˤ.mˤʉːnˤ]. Whereas if the trigger of emphasis is in the onset position of the second syllable as in (4-14. j) /man.ðˤuːr/, then the emphasis spreads progressively and gradually from /ðˤ/ to the adjacent segments in the same syllable /man.ðˤʉːrˤ/. Then, the emphasis spreads from /ðˤ/ regressively covering the adjacent segments in the preceding syllable gradually [mˤɑnˤ.ðˤʉːrˤ]. In addition, another challenging set of examples in HA are the following shown in (4-15) with two pharyngealised segments located in different syllables.

Example 4-15 double emphasis source in HA

	Direction	Input	Output	Gloss
a.	**Bidirectional**	/muðˤ.tˤar/	[mˤʉðˤ.tˤɑrˤ]	‘forced’
b.		/maðˤ.buːtˤ/	[mˤɑðˤ.bʉːtˤ]	‘exact’
c.		/musˤ.tˤaf/	[mˤʉsˤ.tˤɑfˤ]	‘aligned’

Interestingly, the examples above show two pharyngealised segments distributed in different syllables, i.e. two sources of emphasis. This situation is yet a more confusing when it come to a gradual analysis with intermediate steps as that of HS-OT. The general rule applies from the examples in (4-15) above. This means that each syllable will have its own source of emphasis. In the example (4-15). a) /ðˤ/ as the first pharyngealised segments spreads its emphasis regressively and gradually covering the first syllable /mˤʉðˤ.tˤar/. Whereas for the second syllable, there is another source of emphasis which is the pharyngealised /tˤ/ in the onset of the second syllable, and so the emphasis spreads from /tˤ/ progressively covering the adjacent segments gradually [mˤʉðˤ.tˤɑrˤ]. Meaning, in a double pharyngealised source in separate syllables each trigger spreads its emphasis accordingly.

On the other hand, the case of the direction of the emphasis spread triggered by the uvular /χ, ʁ, q, ɢ/ segments in HA is a bit different from the other dialects of Arabic reported in the literature studies. Although their similarities are attested in terms of lowering the F_2 of adjacent vowels is attested in Arabic dialects, HA, however, differs in terms of the degree to which the F_2 is lowered as explained earlier. In addition, the uvulars in HA have an extensive emphasis spread effect in which they affect the entire stem word. Nonetheless, the direction of the emphasis triggered by the uvular /χ, ʁ, q, ɢ/ is regressive, progressive and bidirectional.

The examples in (4-16) below exhibit the nature of emphasis spread direction triggered by the uvular /χ, ʁ, q, ɢ/ segments in HA. From the examples in (4-16), it is evident that the uvular /χ, ʁ, q, ɢ/ segments direction of emphasis spread in HA is similar to that of the pharyngealised segments /tˤ, ðˤ, sˤ/. It is worth mentioning that the uvular /q/ presents an interesting case here in HA. It has been reported in the literature that /q/ is an exception as having a very minimum emphasis effect that spreads to the only the adjacent vowel in the same syllable. Although this is the general case, however, the examples presented in (4-16) from my data say otherwise. This means that in some lexical items in HA, /q/ has an emphasis effect that spreads not only to the adjacent vowel but its emphasis goes further covering the entire word regressively as in (4-16. c) /ʃu.ruːq/ → [ʃʁrˤʁːq], progressively as in (4-16. g) /qanʃa/ → [qɑnˤʃˤɑ] and bidirectionally as in (4-16. k) /ma.qar/ → [mˤɑ.qɑrˤ].

Example 4-16 Direction of emphasis spread in HA from the uvular segments

	Direction	**Input**	**Output**	**Gloss**
a.	**Regressive**	/raχ/	[rˤɑχ]	‘luxurious’
b.		/dlaːʁ/	[dˤlˤɑːʁ]	‘a sock’
c.		/ʃu.ruːq/	[ʃʁrˤʁːq]	‘sunrise’
d.		/maraɢ/	[mˤɑrˤɑɢ]	‘stew’
e.	**Progressive**	/χam/	[χɑmˤ]	‘vacume’
f.		/ʁab/	[ʁɑbˤ]	‘disappear’
g.		/qanʃa/	[qɑnˤʃˤɑ]	‘a serving dish’
h.		/ɢarm/	[ɢɑrˤmˤ]	‘chivalrous’
i.	**Bidirectional**	/bu.χuːr/	[bˤʁ.χʁːrˤ]	‘scent’
j.		/ra.ʁi/	[rˤɑ.ʁɨ]	‘weeping’

k. /ma.qar/ [mˤɑ.qɑrˤ] ‘headquarters’

l. /maɢ.lab/ [mˤɑɢ.lˤɑbˤ] ‘a prank’

Likewise, the direction nature of emphasis spread is conditioned by the position of the emphatic segment, i.e. pharyngealised and uvular segments. The emphasis spreads regressively first if the emphatic segment is located in the coda position of the first syllable as in (4-16. l) /mˤɑg.lab/ then the emphasis goes progressively to the second syllable [mˤɑg.lˤɑbˤ] . Whereas in (4-16. i) the emphasis spreads progressively first when the emphatic segment is located in the onset position of the second syllable /ra.ʁɨ/ then, it goes backwards covering the first syllable [rˤɑ.ʁɨ]. All this emphasis spread gradually.

An acoustic evidence for the direction of emphasis spread of the pharyngealised /tˤ, ðˤ, sˤ/ and the uvular /χ, ʁ, q, ɢ/ segments in HA is provided in Table 4-4 below. The measurements of the lower F_2 in the vicinity of these emphatic segments in different positions, crucially prove the emphasis spreads in different directions ultimately covering the entire word. In addition, and for comparison reasons, the plain counterpart /t/ is added to show the significant difference in the F_2 drop between the pharyngeal /tˤ/ and the plain /t/, for example, in different positions.

Table 4-4: Direction of emphasis spread in HA

	Emphasis direction	**Segments**	**Examples**	**Gloss**	**F2 in Hz.**
a.	**Regressive**	/tˤ/	[ħˤɑtˤ]	‘put’	1107
b.		/t/	[ħat]	‘degrade’	1822
c.		/χ/	[rˤɑχ]	‘luxurious’	1018
d.		/ɢ/	[bˤɑɢ]	‘pale’	1160
e.	**Progressive**	/tˤ/	[tˤɑːlˤ]	‘overdue’	1225

f.		/t/	[taːl]	‘drag’	1828
g.		/χ/	[χɑmˤ]	‘vacuum’	1080
h.		/ɢ/	[ɢɑrˤmˤ]	‘chivalrous’	1191
i.	**Bidirectional**	/tˤ/	[mˤɑsˤtˤʉːrˤ]	‘lined up’	1185 <-> 718
j.		/t/	[mastuːr]	‘hidden’	1784 <-> 1064
k.		/χ/	[bˤʉχʉːrˤ]	‘scent	711 <-> 593
l.		/ɢ/	[mˤɑɢlˤɑbˤ]	‘a prank’	1261 <-> 996

The data in Table 4-4 above show the acoustic measurements of the F_2 in the vicinity of the pharyngealised /tˤ/, the uvular /χ/ and the uvular /ɢ/ in three different positions showing the different directions in which the emphasis spreads causing a lowering in the F_2 values. When the emphatic segment is in a final position, the emphasis spreads regressively as in [ħˤɑtˤ] the F_2 has a low reading at (1107 Hz) in comparison with the plain /t/ in [ħat] having a higher F_2 reading at (1822 Hz) bringing the difference between them at (715 Hz). Whereas if the emphatic segment is located at initial position of the word, the emphasis spreads progressively as in [χɑmˤ] showing a low F_2 measurement at (1080 Hz). Though, if the emphatic segment is located at middle position of the word as in [mˤɑglˤɑbˤ], then the emphasis spreads bidirectionally causing low F_2 readings of the preceding vowel at (1261 Hz) and the following vowels at (996 Hz). These low measurements of F_2 in the vicinity of different emphatic segments in HA and in different positions, crucially prove the emphasis spreads in different directions ultimately covering the entire word. Moreover. For the pharyngealised segments in particular, their emphasis spreads even further, i.e. regressively across the word boundary.

The previous section has discussed the direction of emphasis spread in HA. It has also provided an acoustic evidence of the extent to which the emphasis spreads from both the pharyngealised as well as the

uvular segments in HA. It has been shown that the pharyngealised, as expected have a long-distance emphasis spread in HA. More interestingly, the uvular segments proved to have a long-distance emphasis spread in HA which covers the entire word.

Although the word is the domain for emphasis spread triggered by the pharyngealised and the uvular segments in HA. In other dialects of Arabic, it has been reported in the literature that such spread can be blocked by a number of high segments, i.e. consonants and vowels as a result to their opacity to emphasis. These segments are: /j, ʃ, ʒ, w, I, iː, u/ (Gazeli, 1977; Card, 1983; Heath, 1987; Younes, 1994; Davis, 1995; Watson, 2002). The following section investigates the blockers of emphasis in HA, if there is any.

4.5 Blockers of emphasis spread in HA

This section investigates the blockers of emphasis in HA. The effect of the opaque segments in a given dialect or a phenomenon such as pharyngealisation and uvularisation is manifested in the blockage of the emphasis to spread beyond these opaque segments. Meaning, the opaque segments block the emphasis spread progressively not regressively (Card, 1983 p.173).

On the other hand, this spread of pharyngealisation can be blocked under certain conditions. Ferguson (1956) and Elshafei (1991) report that when the pharyngealised /lˤ/ is preceded by the vowel /iː, i/, the emphasis spread is blocked resulting in a plain /l/. According to Davis (1995), in addition to the vowels /i, iː/, the emphasis spread of the pharyngealised segments is blocked in Saudi Arabic by the consonant /j/ when it precedes a pharyngealised segment in a word. However, if /j/ follows a pharyngealised segment, it does not block the spread of the emphasis, which means that the emphasis is blocked regressively, not progressively.

Nevertheless, some dialects of Arabic exhibit no opacity to emphasis triggered by the pharyngealised segments where emphasis spread is neither blocked regressively nor progressively such as 9abady Arabic and Kuwaiti Arabic (Sakarna, 1999 p.123; Aldaihani, 165) respectively.

Based on HA data, I argue that there are no opaque segments to the emphasis triggered by the pharyngealised segments /tˤ, ðˤ, sˤ/ that block the regressive and progressive spreading of emphasis. The following examples in (4-17) exhibit that the proposed opaque segments in the literature /j, ʃ, ʒ, w, I, iː, u/[44] are transparent to the pharyngealised- triggered emphasis in HA.

Example 4-17 No opaque segments of pharyngealised /tˤ, ðˤ, sˤ/ in HA

Blockers	**Input**	**Output**	**Gloss**	**Direction**
/j/	/tˤajjaːt/	[tˤɑjˤjˤɑːtˤ]	‘layers’	Right
	/ðˤaːjf/	[ðˤɑːjˤɨfˤ]	‘guest’	
	/sajtˤar/	[sˤajˤtˤɑrˤ]	‘dominate’	Left
/ʃ/	/tˤaʃʃar/	[tˤɑʃˤʃˤrˤ]	‘splash’	Right
	/batˤʃa/	[bˤɑtˤʃˤɑ]	‘Caesarian’	
	/ʔaʃtˤar/	[ʔˤʃˤtˤɑrˤ]	‘the best’	Left
/w/	/sˤuwaːmiʕ/	[sˤʉwɑːmɨʕˤ]	‘rooms’	Right
	/ʔatˤwaːr/	[ʔˤɑtˤwˤɑːrˤ]	‘stages’	
	/ʔawðˤaːʕ/	[ʔˤɑwˤðˤɑːʕˤ]	‘situations’	Left
/i/	/ðˤifir/	[ðˤɨfˤirˤ]	‘nail’	Right
	/sˤifir/	[sˤɨfˤirˤ]	‘zero’	
	/nitˤaħ/	[nˤɨtˤɑħˤ]	‘gore’	Left
/iː**/**	/sˤiːn/	[sˤɨːnˤ]	‘China’	Right
	/ʕasˤiːr/	[ʕˤɑsˤɨːrˤ]	‘juice’	
	/biːtˤaːr/	[bˤɨːtˤɑːrˤ]	‘veterinarian’	Left
/u/	/ðˤulm/	[ðˤʉlˤmˤ]	‘injustice’	Right
	/sˤuk/	[sˤʉkˤ]	‘close’	

[44] Although /ʒ/ is considered opaque is some Arabic dialects, it is not attested in HA.

/futˤar/ [fˤʉtˤɑrˤ] ‘breakout’ Left

The emphasis triggered by the uvular /χ, ʁ, q, ɢ/ segments in HA is not blocked by the opaque segments proposed in the literature /j, ʃ, ʒ, w, I, iː, u/. whether these segments are located right or left to the emphatic segments, the emphasis still spreads beyond them. The examples in (4-18) below demonstrate that the opaque segments are transparent to the emphasis regressively and progressively.

Interestingly, the uvular /q/ exhibits an emphasis that goes beyond the adjacent vowel. In the word [qɑwˤɑːmˤ] /q/ extends its emphasis progressively throughout the entire word. Likewise, in the example [rˤɑqiːqɑ] /q/ extends its emphasis bidirectionally covering the entire word. This coincides with observations from (Woidich, 1999) about the extended emphasis spread of /q/ with some exceptions. However, it contradicts with Watson’s (2002) notes on Cairene and Owen’s (2013) notes on Arabic who argue that /q/ has a limited emphasis spread to the adjacent vowel only.

Example 4-18 No opaque segments of uvulars /χ, ʁ, q, ɢ/ in HA

Blockers	**Input**	**Output**	**Gloss**	**Direction**
/j/	/ʁaːjib/	[ʁɑːjˤbˤ]	‘absent’	right
	/faːjiχ/	[fˤɑːjˤiχ]	‘annoyed’	left
	/ɢajmar/	[ɢɑjˤmˤɑrˤ]	‘cream’	
/ʃ/	/qrʉːʃ/	[ɢrˤʉːʃ]	‘coins’	right
	/ʁaʃmara/	[ʁɑʃˤmˤɑrɑ]	‘joking’	
	/ʃaχ/	[ʃˤɑχ]	‘pee’	left
/w/	/qawam/	[qɑwɑːmˤ]	‘figure’	right
	/ʔawrɑːq/	[ʔˤɑwˤrˤɑːɢ]	‘papers’	left
	/zawaʁ/	[zˤɑwˤɑʁ]	‘deflected’	
/i/	/laːʁi/	[lˤɑːʁɨ]	‘cancelled’	right
	/ɢibaʕ/	[ɢɨbˤɑʕ]	‘spread’	left
	/zibaχ/	[zˤɨbˤɑχ]	‘lie’	

/i:/	/χi:ra/	[χɨ:rˤɑ]	‘goodness’	right
	/raqi:q/	[rˤɑqɨ:q]	‘tender’	
/u/	/χubar/	[χʉbˤɑrˤ]	‘Khobar’	right
	/buɢɑr/	[bˤʉɢɑrˤ]	‘cows’	left

The acoustic measurements of F_2 values of the vowels in the vicinity of the pharyngealised /tˤ, ðˤ, sˤ/, the uvular /χ, ʁ, q, ɢ/ segments confirm that there are no opaque segments to the emphasis spread in HA. The low F2 value means that the emphasis is not blocked. The examples in Table 4-5 show three examples of the pharyngealised /sˤ/, the uvular /q/ and the uvular /ɢ/ in the vicinity of opaque segments /i:, i/. A minimal pair example with the plain counterpart /s/ is added for comparison of the F_2 drop value following /sˤ/.

Table 4-5: No opacity to emphasis in HA

	Position of opaque	**Segments**	**Examples**	**Gloss**	**F2 in Hz.**	**Difference**
a.	**Right**	/sˤ/	[sˤɨ:nˤ]	‘China’	1136	552
b.		/s/	[si:n]	‘letter s’	1688	
c.	**Right**	/q/	[rˤɑqɨ:q]	‘tender’	1148	
d.	left	/ɢ/	[rˤɨ:ɢ]	‘saliva’	878	

As shown in the table above, the F_2 value of the vowel /ɨ/ in the vicinity of the pharyngealised /sˤ/ in [sˤɨ:nˤ] shows a significant drop measuring at (1136 Hz) in comparison to the value of the F_2 of the vowel /i/ in the minimal pair [si:n] measuring at (1688 Hz) bringing the difference between the F_2 values to (552). Likewise, the F_2 value is similarly low measuring at (1148 Hz) for the vowel /ɨ/ in the vicinity of the uvular /q/ in [rˤɑqɨ:q]. In addition, a substantial low F_2 value for /ɨ:/ in the vicinity of the uvular /ɢ/ measuring at (878 Hz) in [rˤɨ:g]. These low F_2 values in the vicinity of the reported opaque segments /i, i:/

and others, although opaque in some Arabic dialects, are acoustically evident, however, that they have no influence in blocking the emphasis of the HA triggered by the pharyngealised /tˤ, ðˤ, sˤ/ and the uvular /χ, ʁ, q, ɢ/ segments.

This section has investigated the blockers of emphasis spread in HA. The data in HA show that the reported blockers in the literature are transparent for emphasis spread in HA disregarding the trigger of emphasis be it the pharyngealised or the uvulae segments. This claim has been proven acoustically. The following section presents other varieties of Arabic dialects and Gulf dialects with respect to some aspects of the emphasis spreading phenomenon.

4.6 Emphasis in Arabic dialects vs. HA:

This section presents other varieties of Arabic dialects and Gulf dialects with respect to some aspects of the emphasis spreading triggered by pharyngealised or the uvulae segments. The examples below explore the emphatic segments that occur in different dialects of Arabic. The most common emphatics found in different dialects of Arabic are: /tˤ, dˤ, ðˤ, sˤ, zˤ/. However, the occurrence of emphatics varies in different dialects of Arabic. The examples in (4-19) below exhibit the emphatic segments and their plain counterparts that occur in Basra Arabic, Syrian Arabic, 9abady Arabic, Palestinian Arabic, Makkan Arabic, spoken in the city of Makkah in Saudi Arabia and Kuwaiti Arabic (Mahdi, 1985 p. 15; Adra, 1999 p. 199; Sakarna 1999 p.119; Card, 1983 p. 49; Kabrah, 2004 p.172; Aldaihani, 2014 p.149) respectively. In addition, Cairene, while /sˤ, tˤ, dˤ/ are preserved, /ðˤ/ on the other hand, is either substituted with /dˤ/ or /zˤ/ as in /ðˤʉlˤmˤ/ ~ [zˤʉlˤmˤ] ‘unfairness’ and /ðˤɑfɨːrˤɑh/ ~ [dˤɑfɨːrˤɑh] ‘braid’ respectively. In addition, there are some cases in which /dˤ/ surfaces as [zˤ] as in /dˤɑːbˤɨtˤ/ ~ [zˤɑːbˤɨtˤ] ‘officer’ (Watson, 2002). Whereas the pharyngealised segments in HA are /tˤ, ðˤ, sˤ/. They are presented in table above in 1-1 above and repeated here for convenience in example 4- 20 below.

Example 4-19 The most common emphatics in Arabic

	Dialect	**Plain**	**Gloss**	**Emphatic**	**Gloss**
a.	Hasawi Arabic	[bit]	‘decide’	[bˤɨtˤ]	‘hit’
		[daːr]	‘house’	[ðˤɑːrˤ]	‘harmful’
		[fað]	‘unique’	[fˤɑðˤ]	‘rude’
		[ʕasiːr]	‘difficult’	[ʕɑsˤɨːrˤ]	‘juice’
b.	Basra Arabic	toːba	‘forgiveness’	tˤoːba	‘ball’
		damm	‘blood’	dˤamm	‘hug’
		safra	‘trip’	sˤafra	‘yellow’ fem.
		---	---	zˤaʁar[45]	‘it became smaller’
c.	Syrian Arabic	darb	‘path’	dˤarb	‘hitting’
		zill	‘indignity’	zˤill	‘shade’
d.	9abady Arabic	ðamm	‘belittle’	zˤamm	‘embraced’
		saːr	‘walked’	sˤaːr	‘became’
e.	Palestinian Arabic	baʕd	‘after’	baʕdˤ	‘some’
		baːs	‘he kissed’	baːsˤ	‘bus’
f.	Makkan Arabic	---	---	rˤaːs	‘head’
		---	---	sarˤag	‘he stole’
		---	---	suːrˤ	‘fence’
g.	Kuwaiti Arabic	taːb	‘repent’	tˤaːb	‘cured’
		darb	‘way’	ðˤarb[46]	‘beating’
		ðil	‘lowness’	ðˤil	‘shading’
		masruːr	‘happy’	masˤruːr	‘well-kept’

The examples in (4-19) show the most common emphatic segments in different dialects of Arabic /tˤ, dˤ, ðˤ, sˤ, zˤ, lˤ, rˤ/ in which they are assumed to be primary emphatics in the dialects mentioned above.

[45] Emphatic /sˤ/ in /sˤaʁar/ surfaces as [zˤ] in [zˤaʁar].
[46] /dˤ/ in KA is substituted with [ðˤ] instead.

Although /rˤ, lˤ/ are controversial in terms of being primary or secondary in the literature, /rˤ/ is considered a primary emphatic in Makkan Arabic while /lˤ/ is considered a primary emphatic in Basra Arabic (Mahdi, 1985; Kabrah, 2004) respectively. /dˤ/ is preserved in Basra Arabic, Syrian Arabic and Palestinian Arabic. Whereas /zˤ/ occurs in Syrian Arabic, 9abady Arabic and Basra Arabic. Moreover, /sˤ/ is substituted with [zˤ] in Basra Arabic in the vicinity of voiced uvular fricative /ʁ/ according to Mahdi (1985).[47]As to Hasawi Arabic, it shares the same three emphatics with Kuwaiti Arabic /tˤ, ðˤ, sˤ/ where the segment /dˤ/ is always substituted with /ðˤ/. The segments /dˤ, ðˤ/ may be lost from a dialect or be substituted with another segment, but the segments /tˤ, sˤ/ are always preserved in all dialects of Arabic. Whereas the pharyngealised segments in HA as presented above are /tˤ, ðˤ, sˤ/ where the inherited /dˤ/ is totally substituted with /ðˤ/ in HA as in the example [ðˤɑːrˤ] 'harmful'. The HA examples are presented in table 1-1 above and some examples are added in examples 4-19 here for the sake of comparison with other varieties of Arabic where they pattern with other varieties such as Kuwaiti Arabic.

The occurrence of the uvularised lateral /lˤ/ in HA patterns with both Basra Arabic and Kuwaiti Arabic in that it appears in the vicinity of the uvulars /χ, ʁ, ɢ/. It is worth noting that in the examples from Kuwaiti Arabic and Basra Arabic, [g] is presented as a source of emphasis. Although [g] is considered to be the uvular [ɢ] in this research on HA as the source of emphasis.

Example 4-20 Occurrence of pharyngealised /lˤ/ HA, KA and BA

	Hasawi Arabic	**Kuwaiti Arabic**	**Basra Arabic**	**Gloss**
a.	[χɑːlˤ]	[χaːlˤ]	[χaːlˤ]	'my mother's brother'
	[χɑbɑlˤ]	[χɑbɑlˤ]	[mχabbalˤ]	'crazy'

[47] The substitution of /sˤ/ →[zˤ] in Basra Arabic is conditioned by being in the vicinity of /ʁ/. In this case, /zˤ/ should be considered as allophone of /sˤ/ not a primary emphatic.

b.	/ʁɑlˤɑbˤ/→[qɑlˤɑbˤ]	[ʁalab]	[ʁilˤab]	‘he won’
	/ʁɑlˤɑ/→ [qɑlˤɑ]	[ʁalˤa]	[ʁalˤa]	‘love’
	[ɢɨfʉlˤ]	[gifulˤ]	[gafulˤ]	‘lock’
	[ɢɑlˤbˤ]	[galˤb]	[galˤub]	‘heart’
c.	[ɢlˤɑːs]	[glˤaːs]	[glˤaːs]	‘glass’ (loan word)

However, /lˤ/ does not always get uvularised in the vicinity of /χ, ʁ/ in Kuwaiti Arabic. This means that /lˤ/ is not a primary emphatic segment, but an allophonic one in Kuwaiti Arabic. Nevertheless, the source of the emphasis from /g/ is debatable in Hasawi Arabic. Whether the source of emphasis is triggered by the voiced velar stop /g/ or from the voiced uvular stop /ɢ/ will be discussed more later. /lˤ/ also appears in loanwords in HA as well as shown in the examples in (4-20).[48] From the examples in (4-20) above, the fricative uvulars /χ, ʁ/ and the voiced uvular stop /ɢ/, they all have an emphasis spread effect in Hasawi Arabic.

HA patterns with Kuwaiti Arabic in terms of the behaviour of emphasis spread phenomenon triggered from the pharyngealised segments regarding the domain of emphasis, the degree of emphasis with no blockers. Nonetheless, two other dialects of Arabic that exhibit comparable characteristics and worth be compared to HA in respect to the pharynyngealisation and uvularisation phenomena: Ammani-Jordanian Arabic and Fessi Moroccan Arabic (Zawaydeh and de Jong, 2011 and Freeman, 2019**)** respectively.

[48] The pharyngealised /bˤ, mˤ rˤ/ also occur in HA, however these secondary emphatics are beyond the scope of this research and therefore they are left for future research.

4.6.1 HA vs. Jordanian and Moroccan Arabic

The emphasis effect in HA on the other hand has a directionality factor that interacts with the type of the trigger, i.e. the pharyngealised vs. the uvular segments. The pharyngealised segments /tˤ, sˤ, ðˤ/ have a heavier degree of emphasis effect spreading regressively/ leftward. Whereas the uvular segments /q, ɢ, χ, ʁ/ have a heavier degree of emphasis effect spreading progressively/ rightward. This is apparent acoustically in the measurements shown in the lowering of F2 presented in the table presented below. The degree of emphasis triggered by the uvular segments in HA is measured accurately via PRAAT.

The behaviour of the uvular stop /q/ in HA is similar to that of the Ammani-Jordanian Arabic and Fessi Moroccan Arabic. Some cases with the trigger /q/ show long-distance emphasis and some cases do not. However, /q/ has more lowering effect on F2 in HA where, surprisingly, the lowering effect of /q/ in this example /qaːl/→ [qɑːlˤ] ‘exaggerate’ is measuring at 1223 Hz progressively. More interesting is the fact that the data from HA show a long-distance emphasis spread triggered by the uvular segments /q, ɢ, χ, ʁ/ which cover the whole word including the prefix, the suffix, i.e. the morphemic boundaries have no effect in blocking the emphasis spread triggered by the uvular segments in HA as proved acoustically in /buχuːr-ik/→ [bˤʉχʉːrˤ-ɨkˤ] ‘your scent’ and /ʔa-χɑ.bbir/→ [ʔˤɑ-χɑbˤ.bˤɨrˤ] ‘to tell’, see page 117-119. It is worth mentioning that in HA the emphasis effect spreads regressively when the trigger is in word-final position, it spreads progressively when the trigger is in word-initial position, and it spreads bidirectionally when the trigger is in word-medial position covering the whole word. The examples from HA presented below illustrate the emphasis effect triggered by the pharyngealised and uvular segments in both directions regressive and progressive. The emphasis covers the entire word in HA. Most importantly, it is apparent that the emphasis the from the uvular segment has a long-distance effect. What is also distinctive about HA is the interaction between the type of the trigger with the direction and the degree of emphasis triggered by pharyngealised vs. uvular segments. When the trigger is a pharyngealised segment, then the

emphasis, i.e. the lowering of F2 is grater leftward/ regressively. Whereas when the trigger is a uvular segment, then the emphasis, i.e. the lowering of F2 is grater rightward/ progressively. This has been proved acoustically as the data show in the table below.

Table 4-6 Pharyngealisation and uvularisation in HA

Trigger	**Example**	**Gloss**	**F2**
/tˤ/	[tˤɑːlˤ]	'overdue'	1225 Hz
	[bˤɑlˤɑːtˤ]	'tiles'	1190 Hz
/ðˤ/	[ðˤɑːlˤ]	'remain'	1250 Hz
	[ħɑðˤ]	'luck'	1173 Hz
/sˤ/	[sˤɑːlˤ]	'attack'	1204 Hz
	[bˤɑːsˤ]	'bus'	1085 Hz
/χ/	[χɑːrˤ]	'drip'	1119 Hz
	[χɑmˤ]	'vacuum'	1080 Hz
	[rˤɑχ]	'luxorius'	1174 Hz
/ʁ/	/ʁɑrˤ/→ [qɑrˤ]	'ripe'	1038 Hz
	/dbˤɑːʁ/→ [dbˤɑːq]	'tan'	1184 Hz
/q/	[qɑːlˤ]	'exaggerate'	1223 Hz
	[ʕɑːq]	'ungrateful'	1016 Hz
/ɢ/	[ɢlˤɑbˤ]	'heart'	1111 Hz
	[bˤɑɢ]	'pale'	1165 Hz

It is also worth pointing out that from the data in table above, the uvular stop /q/ shows a heavy emphasis effect in [qɑːlˤ] 'exaggerate' with a low F2 measuring at 1223 Hz as well as in [ʕɑːq] 'ungrateful' with a low F2 measuring at 1016 Hz. This proves that /q/ is still an active emphasis trigger in HA and a strong one as illustrated.

Zawaydeh and de Jong (2011) refer to the pharyngealisation phenomenon in their study as uvularisation of Ammani- Jordanian Arabic. They report the emphasis spread triggered by the pharyngealised/ coronal emphatic segments /tˤ, dˤ, sˤ/ as well as the uvular stop segment /q/.

According to Davis (1995), the conditions of vowels differ according to their *"uvularized"/* pharyngealised triggers. There might be blocking of emphasis spread. Cairene and Moroccan Arabic are two dialects that show similar behaviour to Ammani- Jordanian Arabic in respect to the pharyngealisation phenomenon and reported in other studies (El-Dalee, 1984 and Heath, 1987) respectively. El-Dalee (1984) focuses on the emphasis effect triggered by the pharyngealised segments in Cairene Arabic. The emphasis weakens the further the target vowels are from the trigger in a given word and the emphasis does cover the whole word. Whereas Heath (1987) reports on the emphasis effect triggered by the pharyngealised segments as well as the uvular stop /q/ in Moroccan Arabic.

The difference between pharyngealised and non-pharyngealised/ *"uvularized"* and "non- *uvularized"* is represented by a binary feature in previous analyses of the phenomenon. The difference in the degree of emphasis between the emphatic and non-emphatic is roughly 500 Hz. Nevertheless, Zawaydeh and de Jong (2011) find four levels of emphasis spread triggered by the segments they examined, i.e the pharyngealised /tˤ, dˤ, sˤ/ and the uvular stop /q/ depending on how far the target vowels are from the trigger in the word. The emphasis degree is the strongest the close it is to the emphatic triggers. The four levels of F2 lowering are (vowels right before the trigger, vowels right after the trigger, vowels in the vicinity of /q/ and all the remaining vowels).

The direction of the emphasis spread triggered by the emphatic segments is not restricted/ blocked by the high segments /j, i, w, u, ʃ/ regressively or progressively in Ammani- Jordanian Arabic, i.e. no emphasis blockers interaction in this dialect of Arabic. The occurrence of the primary uvular segment /q/,

however, is the only context in which emphasis blockers are active. Nevertheless, the emphasis blocking induced by /q/ does not apply in all cases.

The distance to which the emphasis spread extends is affected by how far the target vowels are form the triggers in each direction. And the type of the trigger, whether it is a coronal emphatic segment or the primary uvular /q/. The closer the target vowel is to the trigger the more emphasised it is with a lower F2. Though, the anticipatory/ regressive emphasis usually spreads strongly for the coronal emphatic segments up to the coda of the preceding word when the trigger is in word- final position. Whereas when it is in a different position in the word, i.e. word- initial or word-medial then it doesn't cover the whole word. On the other hand, the distance of the emphasis spread trigger by /q/ is not that extensive. It spreads as far as two syllables from the trigger /q/, but it weakens as the vowel target appears further at about the 3rd syllable from the trigger /q/.

The degree of emphasis from the coronal emphatics differs from the one from the uvular /q/. Meaning that the uvular stop /q/ has a lesser emphasis effect of lowering the F2 between 1300-1500 Hz. Whereas the emphatics have a stronger emphasis effect of lowering F2 between 1100-1300 Hz and anything between 1500-1700 Hz is non-emphatic in Ammani-Jordanian Arabic.

The idea of Zawaydeh and de Jong's (2011) paper is that uvularized/ pharyngealised coronal segments /$t^{ʕ}$, $s^{ʕ}$, $d^{ʕ}$/ have an emphasis spread effect that weakens the further the target is located/ positioned from the trigger in Ammani-Jordanian Arabic. However, this effect is directionally conditioned, i. e. the regressive/ anticipatory spreading is not affected or weakened if the trigger is in word-final position. Whereas if the emphasis spreading is a progressive/ perseveratory one, then the weakening of emphasis effect is apparent acoustically. The data in Table 4-7 below is drawn from Zawaydeh and de Jong's (2011) emphasis spread phenomena in Ammani-Jordanian Arabic. The target vowels are underlined.

Table 4-7 Pharyngealisation and uvularisation in Ammani-Jordanian Arabic

Trigger	**Example**	**Gloss**	**F2**
/tˤ/	[tasallatˤ]	‘he overruled’	1100 Hz, 1300, 1200
	[salatˤa:t]	‘salads’	1100 Hz
/dˤ/	[dˤajjak]	‘your light’	1100 Hz
	[ʕadˤalaːtak]	‘your muscles’	1140 Hz
/q/	[qallalatha]	‘she lessened’	1450 Hz
/x/	[xaja:l]	‘imagination’	1600 Hz

The examples in the table above exhibit the emphasis spread phenomenon in Ammani-Jordanian Arabic. The emphasis spreads regressively and progressively in this dialect. However, the examples [tasallatˤ] ‘he overruled’ and [salatˤa:t] ‘salads’ show that the lowering of F2 is heavier progressively when the trigger of emphasis is one of the coronal emphatics/ pharyngealised segments /tˤ, dˤ, sˤ/. Whereas the uvular segments in HA have a heavier lowering effect of F2 progressively while the pharyngealised segments have a heavier lowering effect of F2 regressively as presented in the HA data above.

It is also worth noting that the emphasis effect triggered by the uvular stop /q/ is noticeable in Ammani-Jordanian Arabic, but it can be blocked in some instances by high segments. Yet this blocking is not significant therefore it cannot be generalised in the dialect. It is also worth noting that as the data show the uvular fricative /x/ has no uvularisation effect in this dialect on following vowels and that shows acoustically in the measurement of the F2 at 1600 Hz.

In Fessi Moroccan Arabic, Freeman (2019) focuses on rhotic emphasis and uvularisation. Acoustic information on spreading is available from coronal emphatics, and uvulars may well be compared to HA. The uvularisation effect triggered by the uvular stop /q/ in Moroccan Arabic is classified as intermediate on the F2 in comparison to the emphasis effect triggered by the coronal pharyngealised segments and the

plain/ non- pharyngealised segments in the same dialect in the vicinity of the low vowel /a/. For example, the uvular /q/ triggers a lowering in the F2 in /baqi/ ‘remainder’ measuring at 1310.1 Hz which is a middle measurement between the trigger from the coronal emphatic /tˤ/ in /batˤ/ ‘ducks’ measuring at 1240.1Hz and the plain coronal /t/ in /bat/ ‘slept’ measuring at 1757.2 Hz. On contrast, the voiceless uvular fricative /χ/ appears to have a weaker lowering effect on the F2 in of the low vowel /a/ than the one of the uvular stop /q/. In /χatəm/ ‘a ring’ the F2 is measuring at 1627.8 Hz. Another weak lowering effect on the F2 in of the distant low vowel /a/ is apparent in /χəbbaz/ ‘baker’ measuring at 1691.5 Hz. Whereas the voiced uvular fricative /ʁ/ has a heavier lowering effect on the F2 in /dmaʁ/ ‘brain’ measuring at 1340.7 Hz. No matter what the direction of the emphasis spread is, be it regressive or progressive the same pattern applies. The data in the table below is drawn from Freeman’s (2019) on Fessi Moroccan Arabic.

Table 4-8 Pharyngealisation and uvularisation in Fessi Moroccan Arabic

Trigger	**Example**	**Gloss**	**F2**
/tˤ/	[batˤ]	‘ducks’	1240 Hz
	[tˤiːsan]	‘bowls’	1523.6 Hz
/χ/	[χatəm]	‘ring’	1627.8 Hz
	[χəbbaz]	‘baker’	1691.5 Hz
/ʁ/	[dmaʁ]	‘brain’	1340.7 Hz
/q/	[ba̲qi]	‘remainder’	1310.1 Hz
	[baqi̲]	‘remainder’	2378.4 Hz

It is worth mentioning that in the vicinity of the high vowel /i/, only the pharyngealised segments such as /tˤ/ has an emphasis effect with a low F2 in in the vicinity of the high vowel /i/ as in /tˤiːsan/ ‘bowls’ measuring at 1523.6 Hz. Whereas no emphasis effect is shown on the F2 of the high vowel /i/ in the vicinity of the uvular stop /q/ in /baqi/ ‘remainder’ measuring at 2378.4 Hz. Although the uvular fricatives

/χ, ʁ/ exhibit a uvularisation effect they, however, show a weaker and more localised effect that barely cover the adjacent vowel to the trigger in both directions.

HA on the other hand have a heavier degree of emphasis effect of the uvular segments /q, ɢ, χ, ʁ/ than that of the Fessi Moroccan Arabic. The uvulars effect in HA is a long-distance one in which the emphasis can cove the whole word domain regressively and progressively. Unlike the uvular segments in Fessi Moroccan Arabic, the uvular stop /q/ shows an intermediate lowering effect on F2 measuring at 1300 Hz. Whereas the fricative uvular segments /χ, ʁ/ show an average lowering effect on F2 1640 Hz and 1340 Hz respectively. Nevertheless, this lowering effect is a weak one compared to the HA effect as presented in the measurements shown in the lowering of F2 in table 3-3 page 40.

This section has provided comparable data from varieties of Arabic dialect vs. HA in respect to pharyngealisation and uvularisation. As a result, HA presents a unique case in some aspect of the emphasis phenomenon. Although HA coincides with other varieties of Arabic in respect to the emphasis triggered by the pharyngealised segments: /tˤ, ðˤ, sˤ/, it however presents an interesting long-distance emphasis spread triggered by the uvular segments /q, ɢ, χ, ʁ/. The other interesting finding in HA is that the uvular segments present a heavier degree of emphasis spread than the one triggered by the pharyngealised segments. This difference in the degree of emphasis is proven acoustically via PRAAT. The following section presents a phonological analysis of the emphasis spread from the HS-OT perspective.

4.7 Emphasis from HS-OT perspective in HA

This section provides an analysis to the phenomenon of emphasis spread, i.e. pharyngealisation and uvularisation in HA within the framework of HS-OT, the derivational version of OT (Prince and Smolensky, 1993/2004 and McCarthy, 2000) amongst others.

Pharyngealisation as an example of a long-distance assimilation phenomenon that shows '*vowel-*

consonant emphatic' harmony in which the emphasis spreads gradually (Al-Bataineh, 2019). This attribute the capability of HS-OT of tackling such phenomena through predicting the intermediate derivational stages up until the surface output. In addition to the pharyngealisation spread phenomenon, this section will provide analysis to a combination examples of pharyngealisation and assimilation. HS-OT offers a comprehensive analysis of the pharyngealisation and uvularisation phenomena in HA in particular as the focus of this study in this chapter. The variations between the other dialects of Arabic in the emphasis spread phenomenon can be explained by constraints reranking in OT, which is beyond the scope of this research. However, the analysis in this section lays the basis for a more complicated phenomena of assimilation and uvular alternations in HA, to be addressed in chapter five.

4.7.1 Case (1) HA spread of emphasis at a lexical level

The examples in (4-21) exhibit the spread of emphasis in different directions: regressive, progressive and bidirectional. Whether the emphasis is triggered by the pharyngealised /tˤ, ðˤ, sˤ/ or the uvular /χ, ʁ, q, ɢ/ segments, there are no blockers of the emphasis spread at the lexical level in HA. This emphasis spreads gradually from the trigger to the adjacent segments covering one adjacent segment at a time until the entire word domain is emphasized.

Example 4-21

	Direction	**Trigger**	**Input**	**Output**	**Gloss**
a.	**Progressive**	/tˤ/	/tˤaːr/	[tˤɑːrˤ]	'drum'
b.	**Regressive**	/χ/	/ʔaːχ/	[ʔˤɑːχ]	'hurt'
c. i	**Bidirectional**	/tˤ/	/matˤ.buːʕ/	[mˤɑtˤ.bˤʉːʕˤ]	'printed'
c. ii			/maʕ.tˤuːb/	[mˤɑʕˤ.tˤʉːbˤ]	'ruined'

The spread of emphasis is a harmonious mechanism that slowly applies through derivational steps toward the final convergence. The following OT constraints are used to describe the spread of emphasis at lexical level in HA.

SPREAD [RTR] adj (X)

The [RTR] feature of a trigger [tˁ, ðˁ, sˁ] (x) is associated with targeted adjacent segments (y) in the stem enforcing [RTR] spread leftward, rightward and bidirectional gradually segment by segment (Padgett, 1997).

SPREAD [RTR]-D

Every feature [RTR] is linked to every segment within a specific domain (Padgett, 1997).

IDENT-IO [RTR]

The output segment and its input correspondent must have identical values for the feature [RTR] (McCarthy and Prince, 1995).

SPREAD [RTR] adj (X) and SPREAD [RTR]-D are two markedness constraint which are developed to ensure that the emphatic segment makes one single harmonic improvement at a time to an adjacent segment regressively, progressively and bidirectionally with the former, and spreads further covering a specific domain at every single derivational step with the latter. The constraint IDENT-IO [RTR], however, is a faithfulness constraint that militates against the markedness constraints. In order for the emphasis to spread, the low ranked constraint IDENT-IO [RTR] is violated whereas the highly ranked constraints SPREAD [RTR] adj (X) and SPREAD [RTR]-D are satisfied. The following Tableaux (4-1-a to c) illustrate the HS-OT representation of /tˁaːr/ → [tˁɑːrˁ] in HA.

Tableau 4-1: Progressive emphasis spread

(4-1-a) Step 1

/tˤaːr/	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	IDENT-IO [RTR]
(1) Emphasis spreads /tˤaːr/ →[tˤɑːr]			
a. /tˤaːr/	*!		
☞b. /tˤɑːr/			*
c. /tˤɑːrˤ/	*!		*

Tableaux 4-1- (a to c) illustrate the HS-OT representation of the progressive emphasis spread triggered by the pharyngealised /tˤ/ in the word /tˤaːr/ → [tˤɑːrˤ] 'drum' in three derivational steps. At the first step Tableau 4-1-a, the optimal output is candidate (b). It violates the low ranked constraint IDENT-IO [RTR], but satisfies the higher constraints SPREAD [RTR] adj (X) and SPREAD [RTR]-D with one single harmonic improvement where the emphasis spreads progressively to the adjacent segment changing the vowel from /a/ → [ɑ] in /tˤaːr/ → [tˤɑːr] as a result of emphasis spread. Candidate (a) is ruled out since it violates the higher constraint SPREAD [RTR] adj (X) showing no emphasis spread to the adjacent segment. In addition, candidate (c) is also ruled out. Although it satisfies SPREAD [RTR]-D by spreading the emphasis throughout the entire word domain, it however, violates SPREAD [RTR] adj (X) by showing emphasis spread in more than one single segment at this step which is one adjacent segment at a time. The winning candidate from the first derivational step (b) becomes the input to the next step.

(4-1-b) Step 2

/tˤɑːr/	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	IDENT-IO [RTR]
(2) Emphasis spreads /tˤɑːr/→ [tˤɑːrˤ]			
a. /tˤɑːr/	*!	*	
☞b. /tˤɑːrˤ/			*

At the second step, Tableau 4-1-b, the constraint SPREAD [RTR]-D ensures the emphasis spreads further covering every segment in the specified domain in every derivational step which is the entire word at this step. A dotted line is used between the constraints SPREAD [RTR] adj (X) and SPREAD [RTR]-D since they are unranked with respect to each other, which means that the emphasis spread will continue to spread gradually to an adjacent segment at a time until the entire domain is covered. The winning candidate of the second step is [tˤɑːrˤ]. Then, /tˤɑːrˤ/ is inserted as the input of the third step.

(4-1-c) Step 3

/ tˤɑːrˤ/	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	IDENT-IO [RTR]
(3) Convergence /tˤɑːrˤ/→ [tˤɑːrˤ]			
a. /tˤɑːrˤ/			

The third step shows the convergence in which no additional harmonic improvements the final output can undergo. As a result, the input in final step is the optimal output [tˤɑːrˤ]. Tableau 4-1-c above and ranking of the constraints below show the complete harmonic improvement steps that /tˤaːr/ underwent to surface as [tˤɑːrˤ]: SPREAD [RTR] adj (X), SPREAD [RTR]-D >> IDENT-IO [RTR].

Moreover, pharyngealised /tˤ, ðˤ, sˤ/ and the uvular /χ, ʁ, q, ɢ/ segments all pattern together in terms of the emphasis spread at the word level in HA. Consequently, the same constraints and the same strict ranking apply whichever the emphasis trigger is. The following Tableau 4-2 represents the regressive emphasis spread triggered by the uvular /χ/ at a word level in /ʔaːχ/ → [ʔˤɑːχ] 'hurt'. Since the uvular is in word-final position, the emphasis spreads from right to left covering the whole word gradually within three derivational steps including the convergence step where no further harmonic improvements are possible. In order to avoid the repetition of demonstrating the HS-OT emphasis spread analysis triggered by the uvular/χ/ in three separate tableaux, the three derivational steps are shown in the condensed Tableau 4-2 below which shows the derivational steps for the word /ʔaːχ/ → [ʔˤɑːχ] 'hurt'.

Tableau 4-2 below exhibits that for the word /ʔaːχ/ the emphasis spread occurs in three derivational steps. It also shows a one direction emphasis spread, i.e. regressive. At the first step, the emphasis spreads from /χ/ to the adjacent vowels in the same syllable, the winner in this step is (b) /ʔɑːχ/ which violates the faithfulness constraint IDENT-IO [RTR], but satisfies the highly ranked constraint SPREAD [RTR] adj (X). This constraint shows that the spread of emphasis occurs gradually to the adjacent segment of an emphatic in one derivational step. The winner from the first step becomes the input to the second step.

Tableau 4-2 Regressive emphasis spread from the uvular /χ/

/ʔaːχ/	SPREAD [RTR] adj (X)	SPREAD [RTR]-D	IDENT-IO [RTR]
(1) Emphasis spreads /ʔaːχ/ →[ʔɑːχ]			
a. /ʔaːχ/	*!		
☞b. /ʔɑːχ/			*
c. /ʔˤɑːχ/	*!		*
(2) Emphasis spreads /ʔɑːχ/→ [ʔˤɑːχ]			
a. /ʔɑːχ/	*!	*!	
☞b. /ʔˤɑːχ/			*
(3) Convergence /ʔˤɑːχ/→ [ʔˤɑːχ]			
☞a. [ʔˤɑːχ]			

The second step shows the continuous emphasis spread, i.e. one segment at a time, represented by the constrain SPREAD [RTR]-D, at this stage, the emphasis spreads to the onset of the syllable and the winner is (b) /ʔˤɑːχ/ covering the entire domain. The third step shows the convergence in which no additional harmonic improvements occur. As a result, the input in final step is the optimal output /ʔˤɑːχ/ → [ʔˤɑːχ].

No repetition is needed for spreading the emphasis to every adjacent segment in a monosyllabic word at the word level. As a result, the constraint SPREAD [RTR] adj (X) will no longer be used since the emphasis will be considered one derivational step for the sake of abbreviation of number of steps required to achieve the convergence step in the next examples as such I will represent the emphasis spread process by one single step with the constraint SPREAD [RTR], which will be modified when necessary.

The tableaux (4-3) and (4-4) exhibit the HS-OT analysis of the emphasis spread bidirectionally at the word level. HS-OT is capable of demonstrating in which direction the emphasis spreads first. If the trigger of emphasis is at the coda position of the first syllable, then the emphasis spreads regressively first then goes forward covering the second syllable as in /matˁ.buːʕ/ 'printed' shown in Tableau 4-3. Whereas if the trigger of emphasis is at the onset position of the second syllable, then the emphasis spreads progressively first then goes backword covering the first syllable as in /maʕ.tˁuːb/ 'ruined' shown in Tableau 4-4. The constraint SPREAD [RTR] is suitable to convey the emphasis spread with one direction in a word, i.e. regressive and progressive. Therefore, for a disyllabic word with a bidirectional emphasis spread, two more constraints are developed to account for this process, i.e. SPREAD [RTR] Coda-L and SPREAD [RTR] Onset-R.

SPREAD [RTR]

Every feature [RTR] is linked to every segment within a word (Padgett, 1997).

SPREAD [RTR] Coda-L

The emphatics located in coda position must firstly spread its emphasis regressively covering the first part of the word and then spread its ES progressively to the second part of the word (Aldaihani, 2014).

SPREAD [RTR] Onset-R.

The emphatics located in onset position must firstly spread its emphasis progressively covering the second part of the word and then spread its ES regressively to the first part of the word (Aldaihani, 2014).

Tableau 4-3: Emphasis spread bidirectionally at lexical level

(4-3-a) Step 1

/matˤ.buːʕ/	SPREAD [RTR] Coda-L	SPREAD [RTR]	IDENT-IO [RTR]
(1) Emphasis spreads /matˤ.buːʕ/ →[mˤɑtˤ.buːʕ]			
a. /matˤ.buːʕ/	*!		
☞b. /mˤɑtˤ.buːʕ /		*	*

Tableau 4-3 above illustrates the HS-OT analysis of the bidirectional emphasis spread at a lexical level in HA /matˤ.buːʕ/ → [mˤɑtˤ.bˤʉːʕˤ] occurs in three derivational steps. In the first step, the constraint SPREAD [RTR] Coda-L is the active one in determining the direction in which of the emphasis spreads first, i.e. regressively from the coda in the first syllable in the first derivational step covering the whole syllable showing the optimal output from the first pass of Eval is candidate (b) [mˤɑtˤ.buːʕ]. To assure the direction of spread, SPREAD [RTR] Coda-L must outrank SPREAD [RTR]. The winner [mˤɑtˤ.buːʕ] violates SPREAD [RTR] since it does not show emphasis spread throughout the word. The winner also violates IDENT-IO [RTR] since it does not have identical input and output, but it satisfies the highly ranked constraint SPREAD [RTR] Coda-L. The winner of this step is the input into the next derivational step.

(4-3-b) Step 2

/mˤɑtˤ.buːʕ/	SPREAD [RTR] Coda-L	SPREAD [RTR]	IDENT-IO [RTR]
(2) Emphasis spreads /mˤɑtˤ.buːʕ/→ [mˤɑtˤ.bˤʉːʕˤ]			
a. /mˤɑtˤ.buːʕ/		*!	
☞b. /mˤɑtˤ.bˤʉːʕˤ/			*

(4-3-c) Step 3

/mˤɑtˤ.bˤʉːʕˤ/	SPREAD [RTR] Coda-L	SPREAD [RTR]	IDENT-IO [RTR]
(3) Convergence /mˤɑtˤ.bˤʉːʕˤ/ → [mˤɑtˤ.bˤʉːʕˤ]			
☞a. [mˤɑtˤ.bˤʉːʕˤ]			

At the second pass through EVAL, the emphasis spread continues and the optimal candidate is (b) [mˤɑtˤ.bˤʉːʕˤ] where the emphasis spreads progressively covers the second syllable resulting in an entirely emphasized word satisfying the constraint SPREAD [RTR]. Then, the winner of this derivational step is inserted as the input of the next mapping.

As the emphasis spreads through the entire word in [mˤɑtˤ.bˤʉːʕˤ], there are no further harmonic improvements possible. As a result, the convergence occurs in the third step where the optimal output is the same as the input to the final derivational step [mˤɑtˤ.bˤʉːʕˤ].

On the other hand, the condensed Tableau 4-4 below, illustrates the HS-OT analysis of the bidirectional emphasis spread at a lexical level in HA /maʕ.tˤʉ:bˤ/ → [mˤɑʕˤ.tˤʉ:bˤ] occurs in three derivational steps.

Tableau 4-4: Emphasis spread bidirectionally at lexical level

/maʕ.tˤu:b/	SPREAD [RTR] Onset-R	SPREAD [RTR]	IDENT-IO [RTR]
(1) Emphasis spreads /maʕ.tˤu:b/ →[maʕ.tˤʉ:bˤ]			
a. /maʕ.tˤu:b/	*!		
☞b. /maʕ.tˤʉ:bˤ/			*
(2) Emphasis spreads /maʕ.tˤʉ:bˤ/→ [mˤɑʕˤ.tˤʉ:bˤ]			
a. /maʕ.tˤʉ:bˤ/		*!	
☞b. /mˤɑʕˤ.tˤʉ:bˤ/			*
(3) Convergence /mˤɑʕˤ.tˤʉ:bˤ/ → [mˤɑʕˤ.tˤʉ:bˤ]			
☞a. [mˤɑʕˤ.tˤʉ:bˤ]			

This time, the constraint SPREAD [RTR] Onset-R is the active one in determining the direction of which the emphasis spreads first, i.e. progressively from the onset in the second syllable in the first derivational step covering the whole syllable showing the optimal output from the first pass is candidate (b) [maʕ.tˤʉ:bˤ]. To assure the direction of spread, SPREAD [RTR] Coda-L must outrank SPREAD [RTR]. Although [maʕ.tˤʉ:bˤ] violates SPREAD [RTR] in the sense that it does not show a total emphasis spread throughout the word, as well as it violates IDENT-IO [RTR] in the sense that there are changes between inputs and outputs, it however, satisfies the highly ranked constraints SPREAD [RTR] Onset-R with an

emphasis spread from the onset throughout the second syllable. The winner of this step is reinserted as the input for the second step /maʕ.tˤʉːbˤ/.

At the second pass through EVAL, the optimal candidate is (b) where the emphasis spreads regressively covering the first syllable of the word /mˤɑʕˤ.tˤʉːbˤ/ satisfying the constraint SPREAD [RTR]. Then, as the emphasis spreads through the entire word, there are no further harmonic improvements possible.

The convergence occurs in the next step where the optimal output is the same as the input to the third step [mˤɑʕˤ.tˤʉːbˤ]. Since the constraints SPREAD [RTR] Coda-L and SPREAD [RTR] Onset-R are dependent on the position of the source of emphasis, then they are added as needed and the ranking of these two constraints cannot be achieved with respect to each other. Hence the ranking of the constraints from Tableaux 4-3 and 4-4 is as follows: SPREAD [RTR] Coda-L, SPREAD [RTR] Onset-R>> SPREAD [RTR]>> IDENT-IO [RTR].

4.7.2 Case (2) HA spread of emphasis at a morphological level

The examples in (4-22) show the spread of emphasis across morphemic boundaries in HA, i.e. the emphasis spreads from the trigger covering the prefix and the suffix attached to the stem in a given example in HA.[49] Whether the emphasis is triggered by the pharyngealised /tˤ, ðˤ, sˤ/ or the uvular /χ, ʁ, q, ɢ/ segments, the hierarchy of the constraints is strict and viable for both prefix and suffix examples.

Example 4-22

	Direction	Trigger	Input	Output	Gloss
a.	**Prefix**	/sˤ/	/ʔa-sˤnˤɑːnˤ/	[ʔˤɑsˤ.nˤɑːnˤ]	‘I stink’
		/χ/	/ʔa-χbˤɨrˤ/	[ʔˤɑχ.bˤɨrˤ]	‘I tell’

[49] It is worth mentioning that the definite article CVC /ʔil/ is beyond the scope of this research.

b.	**Suffix**	/tˤ/	/tˤɑːrˤ-ik/	[tˤɑː.rˤikˤ]	‘your drum’
		/χ/	/bˤʊχʊːrˤ-ik/	[bˤʊχʊː.rˤikˤ]	‘your scent’

The emphasis spread at the morphological level evolves an additional process, i.e. resyllabification of both the prefixes and the suffixes. The prefix must be anchored to the left edge of the stem in order to occupy the empty coda position of the prefix /ʔa-/ at first through the resyllabification process. After that, the emphasis spread follows regressively and gradually covering the entire word. Similarly, the suffix must be anchored to the stem. Only this time it must be anchored to the right edge of the stem in order to occupy the empty onset position. The suffix /-ik/ is onsetless, which is a fatal violation in Arabic. After the resyllabification of the suffix, the emphasis spread from the anchored segment gradually and progressively covering the entire word.

New constraints are developed to ensure the resyllabification of the prefixes and the suffixes. L-ANCHOR (stem, σ) ensures the resyllabification for the prefix which is attached to the left edge of the stem. Whereas R- ANCHOR (stem, σ) ensures the resyllabification for the suffix which is attached to the right edge of the stem. However, the suffixes such as /-ik/ are onsetless which violates the constraint ONSET since onsetless syllables are prevented in Arabic. The markedness constraint is modified with a specification to suite this domain and to allow the spread of emphasis to go further across the morphemic boundaries. The following are the constraints that are developed to account for two processes.

ONSET

Syllables must have onset (Prince and Smolensky 1993).

L/R- ANCHOR (stem, σ)

The segment that begins (suffix) or ends (prefix) the input of the morphological constituent must stand in correspondence with the segment that begins or ends (stem) the output of the prosodic constituent (McCarthy & Prince 1995).

IDENT-IO- σ number

The number of the syllables in the input must be preserved in its output correspondent.

The HS-OT representation in the examples given in tableaux (4-5) and (4-6) below demonstrate the interaction between two phonological processes. The application of the emphasis spread process depends on the prior application of the resyllabification process. Tableaux (4-5) and (4-6) show the gradual harmonic improvements with two intermediate stages before the final convergence step takes place at the morphological level. HS-OT is capable of depicting every single change within separate derivational steps. To avoid repetition of the emphasis spread steps of individual segments the input in the first step shows emphasised stem in Tableaux 4-7 and 4-8 below.

Tableau 4-5: Emphasis spread at a morphological level (prefix)

(4-5-a) Step 1

/ʔa-sˤnˤɑːnˤ /	L- ANCHOR (stem, σ)	IDENT-IO- σ number
(1) Resyllabification /ʔa-sˤnˤɑːnˤ/ →[ʔasˤ.nˤɑːnˤ]		
a. /ʔa-sˤnˤɑːnˤ/	*!	
☞b. /ʔasˤ.nˤɑːnˤ/		*

Tableau 4-5 shows the three derivational steps that /ʔa-sˁnˁːnˁ/ undergoes to surface as [ʔˁɑsˁ.nˁːnˁ] for the emphasis to spread across the morphemic boundaries covering the segments in the prefix. The first step shows the phonological processes resyllabification that takes place first to enable the pharyngealised /sˁ/ to spread its emphasis further across the morphemic boundary afterward. The prefix must be anchored to the left edge of the stem. To ensure the precedence of the syllabification process first, the constraint L-ANCHOR (stem, σ) is ranked the highest in the hierarchy higher than SPREAD [RTR]. As a result, the pharyngealised /sˁ/ is resyllabified occupying the empty coda position of the prefix /ʔa-/ → [ʔasˁ]. Candidate (a) is ruled out since it fatally violates the highly ranked constraint L- ANCHOR (stem, σ). Although candidate (b) violates the markedness constraint SPREAD [RTR] with two violations and the faithfulness lower ranked constraint IDENT-IO- σ number with one violation, it satisfies L- ANCHOR (stem, σ), so candidate (b) is the winner in this step. Then, it is inserted as an input for the next derivational step.

(4-5-b) Step 2

/ʔasˁ.nˁɑːnˁ/	L- ANCHOR (stem, σ)	SPREAD [RTR]	IDENT-IO- σ number	IDENT-IO [RTR]
(2) Emphasis spreads /ʔasˁ.nˁɑːnˁ/→ [ʔˁɑsˁ.nˁɑːnˁ]				
a. /ʔasˁ.nˁɑːnˁ/		!*		
☞b. /ʔˁɑsˁ.nˁɑːnˁ/				**

The winner output of the first step [ʔasˁ.nˁɑːnˁ] becomes the input to the second derivational step. The second step shows the application of the second process, i.e. emphasis spread with the addition of the constraints SPREAD [RTR] which ranked below L- ANCHOR (stem, σ), but outranks IDENT-IO- σ number.

Whereas the addition of the faithfulness constraints IDENT-IO [RTR] does not conflict with IDENT-IO- σ number hence the dotted line. The winning candidate of this step is (b) /ʔˤɑsˤ.nˤɑːnˤ/ where it satisfies the highly ranked constraint SPREAD [RTR] and violates the lowest ranked one IDENT-IO [RTR]. Whereas candidate (a) is ruled out because of the two violation of SPREAD [RTR] The winner is then reinserted as the input for the next derivational step.

The third step in Tableau 4-5-c below shows the convergence where no further harmonic improvements are possible to the input from the previous derivational step. Therefore, the optimal output of the grammar is [ʔˤɑsˤ.nˤɑːnˤ].

(4-5-c) Step 3

/ʔˤɑsˤ.nˤɑːnˤ/	L- ANCHOR (stem, σ)	SPREAD [RTR]	IDENT-IO- σ number	IDENT-IO [RTR]
(3) Convergence /ʔˤɑsˤ.nˤɑːnˤ/ → [ʔˤɑsˤ.nˤɑːnˤ]				
☞a. [ʔˤɑsˤ.nˤɑːnˤ]				

(Tableaux 4-6-a to c) below show two phonological processes involved in this derivation of /bˤʉ.χʉːrˤ-ik/ → [bˤʉ.χʉː.rˤikˤ] at the morphological level covering the suffix, i.e. resyllabification and emphasis spread in HA.

Tableau 4-6: Emphasis spread at a morphological level (suffix)

(4-6-a) Step 1

/bˤʉ.χʉːrˤ-ik/	ONSET	R- ANCHOR (stem, σ)	IDENT-IO- σ number
(1) Resyllabification /bˤʉ.χʉːrˤ-ik/ →[bˤʉ.χʉː.rˤik]			
a. /bˤʉ.χʉːrˤ-ik/	*!	*	
☞b. /bˤʉ.χʉː.rˤik/			*

The first derivational step in Tableaux 4-6-a shows that candidate (a) is ruled out because of the fatal violation to the highest ranked constraint ONSET with the onsetless suffix /-ik/ as well as candidate (a) violates the other highest ranked markedness constraints R- ANCHOR (stem, σ) since [rˤ] in the coda of the stem is not resyllabified and connected to the suffix [-ik] . The constraint ONSET does not conflict with R- ANCHOR (stem, σ) hence the dotted line. The winner is candidate (b) where the coda of the stem is resyllabified to occupy the empty onset position of the suffix /bˤʉ.χʉːrˤ-ik/ → /bˤʉ.χʉː.rˤik/ satisfying the highly ranked constraints ONSET and R- ANCHOR (stem, σ), but violating faithfulness constraint IDENT-IO- σ number with two violations. The winner of this step is the input for the next derivational step.

(4-6-b) Step 2

/bˤu̶.χu̶:rˤ-ik/	ONSET	R- ANCHOR (stem, σ)	SPREAD [RTR]	IDENT-IO- σ number	IDENT-IO [RTR]
(2) Emphasis spreads /bˤu̶.χu̶:.rˤik/→ [bˤu̶.χu̶:.rˤiu̶kˤ]					
a. /bˤu̶.χu̶:.rˤik/			!*		
☞b. /bˤu̶.χu̶:.rˤiu̶kˤ/					**

The second derivational step shows the second harmonic improvement process, i.e. emphasis spread, which could not be happening before the occurrence of resyllabification process. The winner from the first step is the input into the second derivational step /bˤu̶.χu̶:.rˤik/. At this step, the emphasis spreads progressively and gradually across the morphemic boundaries covering the entire word including the segments in the suffix in the winner candidate (b) /bˤu̶.χu̶:.rˤiu̶kˤ/ satisfying SPREAD [RTR] which is ranked higher than the faithfulness constraints IDENT-IO [RTR].

(4-6-c) Step 3

/bˤu̶.χu̶:rˤ-ik/	ONSET	R- ANCHOR (stem, σ)	SPREAD [RTR]	IDENT-IO- σ number	IDENT-IO [RTR]
(3) Convergence /bˤu̶.χu̶:.rˤiu̶kˤ/ → [bˤu̶.χu̶:.rˤiu̶kˤ]					
☞a. [bˤu̶.χu̶:.rˤiu̶kˤ]					

The input to step three is identical to the output of step two since no further harmonic improvements are possible, which means it is the convergence step and the optimal output is [bˤʉ.χʉː.rˤɨkˤ].

4.7.3 Case (3) HA spread of emphasis at a post-lexical level

The examples in (4-23) below show the nature of the emphasis spread triggered by the pharyngealised segments /tˤ, ðˤ, sˤ/ in HA at the post-lexical level. Unlike the emphasis spread at the lexical and across morphological boundaries levels, at the post-lexical level, the emphasis spread is regressive only and confined to the coda of the preceding word in a phrase. In addition, the coda of the first word must be a plain counterpart /t, ð, s/ to the pharyngealised segments /tˤ, ðˤ, sˤ/ for the emphasis to spread across the word boundary.

Example 4-23

Direction	**Trigger**	**Input**	**Output**	**Gloss**
Regressive	/tˤ/	/ʃaːbbat # tˤɨbˤɨːnˤɑ/	[ʃaːbbatˤ # tˤɨbˤɨːnˤɑ]	‘she started a fire’
	/ðˤ/	/nuwaːfið # ðˤɑːˤkˤkˤɑ/	[nuwaːfiðˤ # ðˤɑːˤkˤkˤɑ]	‘narrow windows’
	/sˤ/	/ħaːris # sˤɑːħˤɨ/	[ħaːrisˤ # sˤɑːħˤɨ]	‘alerted guard’

To avoid repetition of the emphasis spread steps of individual segments, the underlying input in this example as illustrated in Tableau 4-7 shows the emphasis spread throughout the word in [tˤɨbˤɨːnˤɑ] as triggered by /tˤ/ at the lexical level. Therefore, the next step is to count for the harmonic improvement at the post-lexical level where the emphasis regressively spreads covering the preceding coda of the first word. In order to specify the direction in which the emphasis spread from the trigger; I developed the following constraint:

SPREAD [RTR] W2Onset # W1Coda[50]

An emphatic segment in the onset position of the second word must regressively spread the feature value [RTR] to an adjacent plain counterpart segment in the coda position of the first word in the phrase.

Tableau 4-7 below shows the HS-OT constraints and the derivational steps the example /ʃaːbbat # tˤɪbˤiːnˤɑ/ undergoes to reach the optimal output [ʃaːbbatˤ # tˤɪbˤiːnˤɑ] where no further harmonic improvements are possible.

Tableau 4-7: Emphasis spread at the post-lexical level

/ʃaːbbat # tˤɪbˤiːnˤɑ/ → [ʃaːbbatˤ # tˤɪbˤiːnˤɑ]	SPREAD [RTR] W2Onset #	IDENT-IO [RTR]
(1) Emphasis spreads /ʃaːbbat # tˤɪbˤiːnˤɑ/ → [ʃaːbbatˤ # tˤɪbˤiːnˤɑ]		
a. /ʃaːbbat # tˤɪbˤiːnˤɑ/	*!	
☞b. /ʃaːbbatˤ # tˤɪbˤiːnˤɑ/		*
(2) Convergence /ʃaːbbatˤ # tˤɪbˤiːnˤɑ/ → [ʃaːbbatˤ # tˤɪbˤiːnˤɑ]		
☞a. /ʃaːbbatˤ # tˤɪbˤiːnˤɑ/		

Tableau 4-7 above shows the emphasis spread at the post-lexical level for the example /ʃaːbbat # tˤɪbˤiːnˤɑ/ in two derivational steps. At the first step, candidate (a) is ruled out by the fatal violation of the highly ranked constraint SPREAD [RTR] W2Onset # W1Coda. Whereas candidate (b) is the winner [ʃaːbbatˤ # tˤɪbˤiːnˤɑ]. Although it violates the faithfulness constraint IDENT-IO [RTR], it however, satisfies

[50] This constrain is a version of the main constraint: Spread [RTR] which is used for the same purpose, but the domain is different. at the lexical level, at the morphological level and at the post-lexical level. At the lexical and morphological level, the emphasis spreads regressively, progressively and bidirectionally covering the entire word. Whereas at the post-lexical level, the emphasis spreads in one direction, regressively, and is limited to the segment in the coda of the preceding word.

the higher constraint. The output of the first step is the input into the next derivational step. Since there are no further harmonic improvements possible, the convergence occurs in the second step and the optimal output is [ʃaːbbatˤ # tˤɨbˤɨːnˤɑ].[51]

4.7.4 Case (4) Uvular segments Voice assimilation at a post-lexical level

Example 4-24

Direction	Trigger	Input	Output	Gloss
Regressive	/χ/	/ʃmaːʁ # χɑːlid/	[ʃmaːχ # χɑːlid]	'Khalid's head cover'

Voice assimilation in this section refers to voicing and devoicing assimilations. From the examples presented in the literature of several dialects of Arabic, it appears that the voice assimilation is regressive whether it is at the lexical or post lexical level. In other words, the coda of a syllable assimilates to the onset of the adjacent syllable at the lexical level and the coda of the ultimate syllable of a word assimilates to the onset of the initial syllable of the next word at the post lexical level.

The uvulars voice and devoice assimilation in HA occurs between /q, ɢ/ and /χ, ʁ/ at the lexical, morphological and post lexical level. The voice assimilation process of the counterpart uvular segments, i.e. /χ, ʁ/ can be analysed within two steps of intermediate derivation as shown below. Whereas other uvular segments /ʁ, q/ and /q, ʁ/ entails having more derivational steps that include voice assimilation and MoA which will be addressed in the next chapter.

[51] No progressive emphasis spread at post-lexical level in HA.

In HS-OT, McCarthy (2008b, p. 278) introduces different symbols to represent the intermediate stages of the partial assimilation and deletion processes. The symbol /N/, for example, represents the partial assimilation process, in which a nasal segment /n, m, ŋ/ loses its place of articulation specification, but keeps its nasality manner of articulation. Thus, /N/ is the intermediate stage that represents whatever is left of the deleted nasal segment before the next derivational step of copying the place specification of an adjacent segment regressively occurs. This is exemplified in following examples in (4-25):

Example 4-25

a. /n/→ /N/→ [m]	/pan.pa/→ /paN.pa/→ [pam.pa]
b. /n/→ /N/→ [ŋ]	/son.kars/→ /soN.kars/→ [soŋ.kars][52]
b. /m/→ /N/→ [n]	/pam.ta/→ /paN.ta/→ [pan.ta],
c. /m/→ /N/→ [ŋ]	/pam.ka/→ /paN.ka/→ [paŋ.ka].
d. /ŋ/→ /N/→ [m]	/tiŋ.paw/→ /tiN.paw/→ [tim.paw]

Whereas the symbol /H/ represents a placeless oral segment /t/, in a deletion process, in which it gets totally deleted, i.e. /t/→ /H/→ Ø[53] as in /pat.ka/→ /paH.ka/→ [pa.ka]. /H/ represents placeless oral segments such as /t/ and other similar segments like /d/ in deletion or assimilation processes.

Following McCarthy (2008), in this thesis I developed symbols to represent the loss of some specified features of the uvular segments /q, ɢ, χ, ʁ/ in different phonological processes. In a voice assimilation process, the unspecified [voice] feature is represented by the symbol /Ɯ/[54]. It represents the intermediate output in the intermediate derivational step where the segment loses the specification for its original voice feature [voice]. The gradual harmonic improvements and derivational steps for voice assimilations of HA

[52] From McCarthy (2008b, p. 292)
[53] Ø this symbol represents a deleted segment or a segment position that is empty.
[54] In another study that deals with voice assimilation process utilises the symbol /V̥/ (Aldaihani 2014).

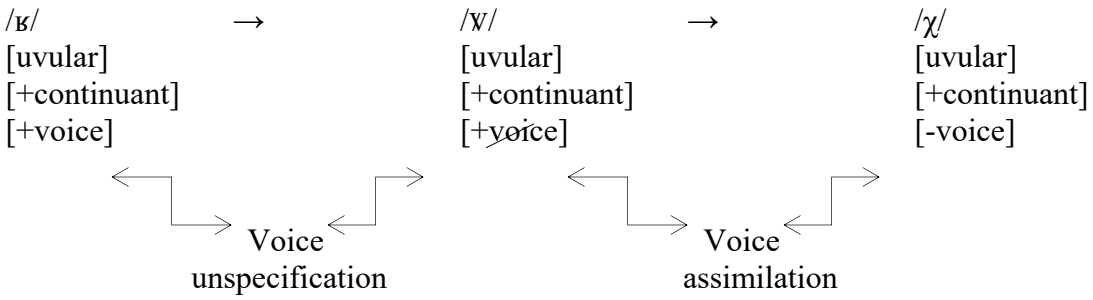
with the features of the uvulars /q/, /ʁ/ and /χ/ are shown in (4-26) below. Whereas the harmonic improvements and derivational steps for manner of articulations assimilations of HA with the features of the uvulars as well as other symbols will be presented in chapter five accordingly.

Example 4-26

Voicing assimilation	/q/ → /Ɣ/ → [ɢ]
	/χ/ → /Ɣ/ → [ʁ]
Devoicing assimilation	/ʁ/ → /Ɣ/ → [χ]

The harmonic improvements with the intermediate derivational steps of the fricative uvular segments /ʁ/ to /χ/ are shown below in Figure **4-1**. The figure shows the significant features of the segments /ʁ/ and /χ/. During the first derivational step the voiced uvular segment /ʁ/ loses its voice specification [+voice], which is represented in this thesis by the symbol /Ɣ/[55]. In the following step, in this example the final step, the unspecified /Ɣ/ harmonically improves and becomes specified as the voiceless uvular /χ/ [-voiced]. Figure **4-1**below illustrates the steps of uvular voice assimilation process.

Figure 4-1 Steps of uvular voice assimilation process



[55] /Ɣ/ refers to unspecified voice feature

To ensure the application of the uvular voice assimilation process at post-lexical level, establishing the intermediate stages of this assimilation process from a HS-OT perspective is necessary. Therefore, the specification of the target uvular input [voice] feature must be lost first through the highest ranked markedness constraint AGREE [VOICE] W2Onset # W1Coda. Then, a specified [voice] feature must be copied from the trigger uvular segment through another highly ranked markedness constraint HAVE VOICE. Both markedness constraints outrank the faithfulness constraints MAX-IO [VOICE] and NOLINK [VOICE]. The following constraints and their definitions are introduced to explain the pattern of uvular voice assimilation at a post-lexical level in HA:

AGREE [VOICE] W2Onset # W1Coda

The uvular coda of the first word must agree to the counterpart onset of the following word in feature [voice] at post-lexical level.

HAVE VOICE

Assign one violation mark for every segment that has no voice specification.

NOLINK [VOICE]

Assign one violation mark for linking the unspecified [Voice] coda /Ɐ/ with the onset in the voice feature.

MAX-IO [VOICE]

Let nasal tier= p1 p2 p3…pn and output Voice tier= p1 p2 p3…pn.

Assign one violation mark for every px that has no corresponding py (McCarthy, 2008b).

The tableaux (4-8-a) - (4-8-c) below show the voice assimilation process in HA from a HS-OT perspective in which the voiced uvular fricative /ʁ/ assimilates to its voiceless counterpart [χ] in a post-lexical level /ʃmaːʁ # χɑːlid/ → [ʃmaːχ # χɑːlid] in three derivational steps. In this example the coda of the

first word in a given phrase assimilates to the onset of a following onset satisfying the highly ranked constraint AGREE [VOICE] W2Onset # W1Coda. The first step shows that candidate (a) is ruled out since it violates the highly ranked constraint AGREE [VOICE] W2Onset # W1Coda by having different specifications of the feature [voice], i.e. /ʁ/ has [+voice] feature while /χ/ has [-voice] feature and because it shows no harmonic improvement since it is exactly the same as the input in this step.

Tableau 4-8: Losing [voice] specification

(4-8-a) Step 1

/ʃmaːʁ # χɑːlid/	AGREE [VOICE] W2Onset #	MAX-IO [VOICE]
(1) Voice Assimilation /ʃmaːʁ # χɑːlid/ → [ʃmaːʏ # χɑːlid]		
a. /ʃmaːʁ # χɑːlid/ /ʃmaːʏ # χɑːlid/	*!	
☞b. /ʃmaːʏ # χɑːlid/		*
c. /ʃmaːʁ # ʁɑːlid/	*!	*

Furthermore, candidate (c) is also ruled out since it violates the highly ranked constraint AGREE [VOICE] W2Onset # W1Coda by reversing the direction of assimilation from regressive to progressive. In candidate (c) the onset /χ/ assimilates the preceding coda /ʁ/ progressively. It also violates the low ranked constraint MAX-IO [VOICE] by having different specifications of the [voice] feature. Whereas candidate (b) is the optimal candidate at this step. Although it violates the low ranked constraint MAX-IO [VOICE] by having no [voice] specification for the coda of the first word, it does not violate the highly ranked constraint AGREE [VOICE] W2Onset # W1Coda. The derivation process continues as the optimal output of this step is inserted as the input for the next passing through EVAL.

(4-8-b) Step 2

/ʃmaːʁ # χɑːlid/	AGREE [VOICE] W2Onset #	HAVE VOICE	MAX-IO [VOICE]	NOLINK [VOICE]
(2) Voice Assimilation /ʃmaːʁ # χɑːlid / → [ʃmaːχ # χɑːlid]				
a. /ʃmaːʁ # χɑːlid/		*!		
☞b. /ʃmaːχ # χɑːlid/				*

The second step exhibits the addition of two constraints. In order for the next step to occur, a [voice] feature specification constraint is added, i.e. HAVE VOICE, which outranks MAX-IO [VOICE]. As a result, candidate (a) is ruled out and candidate (b) is the optimal output, which violates the lowest ranked added constraint NOLINK [VOICE], but satisfies a higher constraint. It is worth mentioning that from the data at hand, the ranking between the constraints MAX-IO [VOICE] and NOLINK [VOICE] cannot be established since their ranking with regard to each other will not affect the result. Therefore, a dotted line is used to represent this notion.

The winner of the second step is fed to the next derivational step. Tableau 4-8-c shows step three: the convergence step in which no additional harmonic improvements the final output undergoes.

(4-8-c) Step 3

/ʃmaːχ # χɑːlid/	AGREE [VOICE] W2Onset #	HAVE VOICE	MAX-IO [VOICE]	NOLINK [VOICE]
(3) Convergence				
☞a. /ʃmaːχ # χɑːlid/				

As a result, the input in the final step is the optimal output. The tableau and ranking of the constraints below show the complete harmonic improvement steps that /ʃmaːʁ # χɑːlid/ underwent to surface as [ʃmaːχ # χɑːlid]: AGREE [VOICE] W2Onset # W1Coda >> HAVE VOICE >> MAX-IO [VOICE], NOLINK [VOICE].

The previous tableaux (4-1) to (4-8) showed the analysis of different phonological processes: re-syllabification, emphasis spread and voice assimilation from a HS-OT perspective in lexical, morphological and post-lexical level in HA. The following case in section 4.7.5 below shows an interaction between two phonological processes in which the voice assimilation must apply before the emphasis process.

4.7.5 Case (5) HA combination example of voice assimilation and spread of emphasis

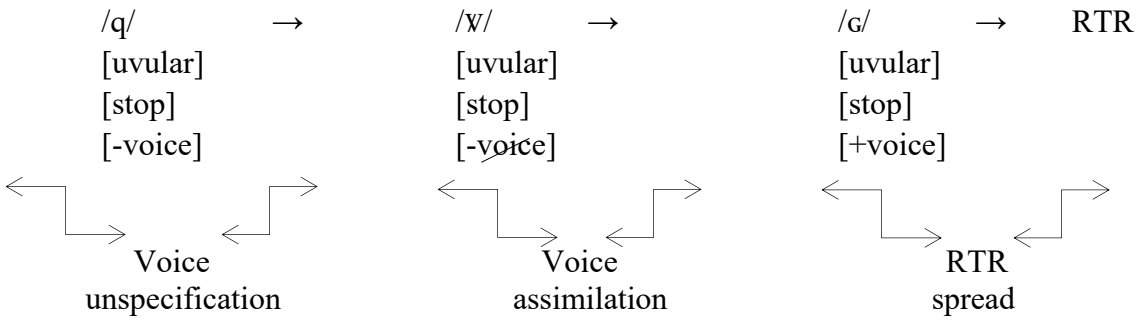
The examples in (4-27) below show the nature of a hybrid example in HA where two phonological processes are involved, i.e. voice assimilation and emphasis spread within the HS-OT. The ranking of the constraints represents the order in which these processes apply.

Example 4-27 Voicing assimilation /q/ → /ɣ/ → [ɢ]

Input	**Output**	**Gloss**
/ʕquːba/	[ʕɢʉːbˤɑ]	‘punishment’

The voice assimilation for /q/ → [ɢ] in the example above is triggered by adjacency to the voiced pharyngeal fricative /ʕ/. On the other hand, emphasis spread triggered by the uvular segments /ɢ/ which, in this particular example, has a further extend emphasis spread effect than the voiceless uvular stop /q/ that covers the entire word. As discussed earlier, I will consider the emphasis spread throughout the entire word as one single harmonic improvement to avoid repetition. Figure 4-2 below illustrates two processes voice assimilation and emphasis spread.

Figure 4-2 Voice assimilation and emphasis spread



The following constraints are repeated below for convenience. Although, some constraints are modified to be well-suited for the lexical level for the example in tableau 4-9. The definitions are presented below:

AGREE [VOICE]

The uvular segment in a CC sequence must agree with the adjacent segment for the feature [voice] at the lexical level.

HAVE VOICE

Assign one violation mark for every segment that has no voice specification.

NOLINK [VOICE]

Assign one violation mark for linking the unspecified [voice] feature /ʁ/ of the uvular segment in a CC sequence with the adjacent segment for the feature [voice].

MAX-IO [VOICE]

Let nasal tier= p1 p2 p3…pn and output Voice tier= p1 p2 p3…pn.

Assign one violation mark for every px that has no corresponding py (McCarthy, 2008b).

SPREAD [RTR]

Every feature [RTR] is linked to every segment within a word (Padgett, 1997).

IDENT-IO [RTR]

The output segment and its input correspondent must have identical values for the feature [RTR] (McCarthy and Prince, 1995).

The following tableaux 4-9 *(a-d)* shows the HS-OT analysis of two phonological processes: voice assimilation and emphasis spread, in one direction: progressive emphasis spread processes in HA at a lexical level in /ʕqʉːba/ → [ʕˤɢʉːbˤɑ], which occurs in four derivational steps. The mapping starts by the insertion of two constraints. The markedness constraint AGREE [VOICE] and the faithfulness constraint MAX-IO [VOICE] with the input /ʕqʉːba/ for the first derivational step. The constraint AGREE [VOICE] outranks MAX-IO [VOICE] as indicated by the solid line between the two constraints in the tableau.

Tableau 4-9: Voice assimilation and emphasis spread

(4-9-a) Step 1

/ʕqʉːba/	AGREE [VOICE]	MAX-IO [VOICE]
(1) Voice Assimilation /ʕqʉːba/→ [ʕʁʉːba]		
a. /ʕqʉːba/	*!	
☞b. /ʕʁʉːba/		*

Tableau *4-9-a* above exhibits the first derivational step which shows that candidate (a) /ʕqʉːba/ is ruled out since it violates the highly ranked constraint AGREE [VOICE] by having different specifications of the feature [voice], i.e. /q/ has [-voice] feature while its adjacent consonant cluster /ʕ/ has [+voice]

feature. Consequently, candidate (b) /ʕɣʊ̶ː/ba/ is the winner at this step. Although it violates the low ranked constraint MAX-IO [VOICE] by having no [voice] feature specification for /q/, which is represented by the symbol [ɣ], it does not violate the highly ranked constraint AGREE [VOICE]. Therefore, it wins and it is inserted as the input for the next derivational step.

(4-9-b) Step 2

/ʕɣʊ̶ː/ba/	AGREE [VOICE]	HAVE VOICE	MAX-IO [VOICE]	NOLINK [VOICE]
(2) Voice Assimilation /ʕɣʊ̶ː/ba/→ [ʕɢʊ̶ː/ba]				
a. /ʕɣʊ̶ː/ba/		*!	*	
☞b. /ʕɢʊ̶ː/ba/				*

The second step demonstrates the addition of two constraints HAVE VOICE and NOLINK [VOICE]. In order for the next step to occur, a [voice] feature specification constraint is added, i.e. HAVE VOICE, which outranks MAX-IO [VOICE]. As a result, candidate (a) /ʕɣʊ̶ː/ba/ is ruled out and candidate (b) [ʕɢʊ̶ː/ba] is the optimal output in this step. It violates the lowest ranked added constraint NOLINK [VOICE], which militates against input and output linked [voice] feature, candidate (b) /ʕɢʊ̶ː/ba/, however, satisfies a higher constraint HAVE VOICE. The winner from this derivational step is the input for the next one. It is worth mentioning that from the data at hand, the ranking between the constraints MAX-IO [VOICE] and NOLINK [VOICE] cannot be established since their ranking with regard to each other will not affect the result. Therefore, a dotted line is used to represent this notion.

(4-9-c) Step 3

/ʕɢʉ:ba/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
(3) Emphasis spreads /ʕɢʉ:ba/ → [ʕˤɢʉ:bˤɑ]						
a. /ʕɢʉ:bah/			*!			
☞b. /ʕˤɢʉ:bˤɑ/						*

The third step shows the application of the second phonological process: the emphasis spread. In order for the emphasis to apply, two additional constraints are added to the tableau: SPREAD [RTR] and IDENT-IO [RTR]. In order to ensure the application order of the emphasis process, the markedness constraint SPREAD [RTR] must outrank the faithfulness constraint MAX-IO [VOICE]. The emphasis from the underlying /q/ is already apparent on the adjacent vowel [ʉ:] as shown in the first input in the first step. However, the third step shows the emphasis spreads from the voiced uvular /ɢ/ in /ʕɢʉ:ba/ covering the entire word. Although candidate (b) [ʕˤɢʉ:bˤɑ] violates the lowest ranked constraint IDENT-IO [RTR], which militates against having different number of emphasis segments in the input and output forms, it still wins. The spread of emphasis is considered as a one single harmonic improvement throughout the word to avoid the repetition of the emphasis spread steps of individual segments.[56]

[56] The presence or absence of /h/ at the end of a word/ʕɢʉ:bˤah/→ [ʕɢʉ:bˤɑh], as a feminine marker, does not make any difference. As a result, it can be deleted /ʕɢʉ:bˤa/→ [ʕɢʉ:bˤɑ].

(4-9-d) Step 4

/ʕˤɢʁːbˤɑ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
(4) Convergence						
a. /ʕˤɢʁːbˤɑ/						

The fourth step shows the convergence in which no additional harmonic improvements the final output can undergo. As a result, the input in the final step /ʕˤɢʁːbˤɑ/ is the optimal output [ʕˤɢʁːbˤɑ]. The ranking of the constraints below shows the complete harmonic improvement steps that /ʕquːba/ underwent to surface as [ʕˤɢʁːbˤɑ]: AGREE [VOICE] >> HAVE VOICE >> SPREAD [RTR] >> MAX-IO [VOICE], NOLINK [VOICE] >> IDENT-IO [RTR].

This section has presented a phonological analysis of the investigated phenomena in HA from a HS-OT perspective. From the examples presented in this chapter, a resyllabification process applies first in certain examples such as those of the morphological level, then the ranking of the assimilation processes in HA can be established as follows: Voice assimilation >> Emphasis spread. In addition, a restricted constraint hierarchy has been established in HA. More complex process will be discussed in chapter five.

4.8 Conclusion

The main focus of this chapter is the emphasis effect triggered by the pharyngealised and uvular segments in HA: pharyngealisation and uvularisation. Therefore, this chapter has investigated the pharyngealised /tˤ, ðˤ, sˤ/ and the uvular /q, ɢ, χ, ʁ/ segments in HA. It has provided a classification of emphatic and other guttural sounds /ħ, ʕ, h, ʔ/ in HA based on the emphasis effect these segments exhibit on adjacent sounds. With the focus on the pharyngealised and uvular segments, the phonemic status of /q/, /g/ and /ɢ/

has been presented and discussed. In addition, other examples in which [g] and [ɢ] as allophonic segments have been presented and discussed with HA examples.

Moreover, the domain of emphasis spread from the pharyngealised and the uvular segments in HA has illustrated that the word stem is the domain of emphasis spread whether it is a mono, disyllabic, or polysyllabic word. In addition, the emphasis extends across the morphemic boundaries covering the prefixes and suffixes. However, the emphasis spread is limited to being the effect triggered by the pharyngealised segments which spreads regressively reaching the plain counterpart coda of the first word of the phrase and not further at the post lexical level.

The emphasis spreads progressively, regressively and bidirectional with no blockers for both the pharyngealised and uvular segments in HA at the lexical level. The data of HA show that the reported blockers in the literature are transparent for emphasis spread in HA, which has been proven acoustically. The emphasis effect, degree of emphasis, triggered by the pharyngealised and uvular segments has been proven acoustically using PRAAT analysis. With which the measurements of the formants: F1, F2 in the adjacent vowels of the investigated segments have been obtained for the participants. An interaction between the type of trigger with the degree and the direction of emphasis have been reported in this chapter. The uvular segments have shown a heavier emphasis spread progressively whereas the pharyngealised segments have shown a heavier emphasis spread regressively. Unlike previous studies in literature, interestingly the uvular segments in HA have shown a long-distance emphasis spread which has been proven acoustically with the analysis of PRAAT. A comparison between HA and other varieties of Arabic dialects has shown the unique case that HA has exhibited in the emphasis phenomenon.

A phonological analysis within the HS-OT perspective of emphasis effect: pharyngealisation and uvularisation has been provided. Utilizing the HS-OT framework in formalizing the processes provided a gradual explanation and a better understanding to more complex examples that would have been difficult

to explain using other framework. The gradual harmonic improvements of HS-OT have predicted the intermediate derivational steps and the order of the application of different phonological processes successfully. This chapter has also provided a phonological interaction between different processes. For example, at the morphological level, the resyllabification must apply prior to the emphasis spread. On the other hand, in a hybrid example, a voice assimilation process applied before the emphasis spreads throughout the entire word.

HS-OT gives a clear prediction and explanation of the intermediate changes that the input undergoes all the way until the final output. All this applies with a strict constraint ranking and a harmonic gradual change with one minimal change at a time. As such, HS-OT shows how an input transforms into an optimal output. By doing so, it lays the basis for the analysis of mor complicated processes to be discussed in the following chapter.

5 Chapter Five: Alternation of Uvular Segments in HA from a HS-OT Perspective

5.1 Introduction

This chapter investigates the phenomenon of uvular segment alternations in HA. More specifically it focuses on the voiceless uvular stop /q/ and the voiced uvular fricative /ʁ/. A brief review of literature on alternation in Arabic and the alternations of the uvular segments in Gulf dialects of Arabic will be presented in section 5.2 and the subsection. HA exhibits unique norms of this alternation phenomenon. Nonetheless, the theoretical assumptions about the existence of this particular phenomenon in the literature, assumes it to be in free variation. The detailed pattern of HA uvular alternations will be presented in section 5.3 and the following subsections. This chapter will also provide a reference to other languages that demonstrate similar phenomena in section 5.4. The pattern of HA that will be presented here from this original study contradicts the standard assumption of free variation in accounts of uvular segments in the similar observed phenomenon in Gulf dialects of Arabic, and offers an alternative account of the *spirant-stop* alternation phenomenon in HA in particular. Finally, the alternation phenomenon in uvular segments is phonologically analyzed from a HS-OT perspective in section 5.5. The pattern of convergence that exists in the alternation of the uvular segments in HA under the HS-OT framework supports a fortition process, /ʁ/ → [q], justifying its superiority to a spirantisation process, /q/ → [ʁ].

The uvular alternation process is assumed in the literature to be phonologically unconditioned and in free variation in other varieties of Arabic dialects in the Gulf area. The goal of this chapter is to investigate whether the alternation that HA exhibits in [q] and [ʁ] is free variation or governed with a clear pattern, what governs this phenomenon, and whether the alternation is phonological or other linguistic constraints are in action

The examples 5-1 below give a foreshadowing to the type of uvular /q/ and /ʁ/ alternations in HA that will be discussed in this chapter.

Example 5-1 Types of alternations of the uvular segments in HA

Alternating uvular	**Input**	**Output**	**Gloss**	**Type of alternation**
/q/	/wˤɑqʉːrˤ/	[wˤɑqʉːrˤ]	‘dignified’	No change to [q]
	/ʕqɑːlˤ/	[ʕɢɑːlˤ]	‘male head piece’	/q/ → [ɢ]
	/tɑqriːban/	[tɑʁriːban]	‘almost’	/q/ → [ʁ]
/ʁ/	/taʁrˤiːd/	[taʁrˤiːd]	‘tweet’	No change to [ʁ]
	/buʁðˤ/	[buqðˤ]	‘detest’	/ʁ/ → [q]

The examples above represent five types of alternations of the uvular segments /q/ and /ʁ/ in HA. First, the uvular stop is preserved [q] with no changed in the vicinity of back vowels [ɑ] and [ʉ]. Second, the voiceless uvular stop /q/ is voiced to [ɢ]. Third, the voiceless uvular stop /q/ is changed into the voiced uvular fricative [ʁ] as a result of assimilation processes of the coda of the first syllable /q/ to the onset of the second syllable /rˤ/. Fourth, the voiced uvular fricative is preserved [ʁ] because of the adjacency of /ʁ/ in the coda of the first syllable and /rˤ/ in the onset of the second syllable. Finally, the voiced uvular fricative is changed into the voiceless uvular stop [q] due to the adjacency to a pharyngealised segment /ðˤ/. More examples and the detailed pattern of HA uvular alternations will be presented in section 5.3 and the subsections. Though the following section presents an overview about alternation of segments in Arabic (Alsohaimi, 1995) and the uvular segment alternations in particular in Gulf dialects of Arabic (Alamadidhi, 1985; Hussain, 1985) amongst others.

5.2 Pattern of alternation in Arabic

Sound alternation is a very important feature in the Arabic language to the extent that it differentiates the various dialects of Arabic. It is argued that the alternation in Arabic is governed (Alsohaimi, 1995 p. 9). In the process of alternation in Arabic sounds, the preservation of underlying elements, or '*origins*', occurs as the sound alternation, or '*substitution*', unfolds. Alsohaimi (1995 p. 28) includes some examples and important information about the written representation of phones in 'Alajreetiyyah' *[ʔalʔaʤriːtɪyyah]*, a language that has a letter for each sound produced. So 'Alajreetiyyah' *[ʔalʔaʤriːtɪyyah]* is the first language to have an alphabet for writing. However, the system includes the consonants, but not the vowels, *short vowels*, and is called 'abjadiyyah' *[ʔabʤadɪyyah]* after the order of the alphabet in the Alajreetiyyah *[ʔalʔaʤriːtɪyyah]* language. The name 'abjadiyyah' *[ʔabʤadɪyyah]* is still used in Arabic to refer to the alphabet.

On the other hand, the Kan'ani language, which is the most closely related to Arabic, is also Alajreetiyyah *[ʔalʔaʤriːtɪyyah]*, since they both have contrastive /ħ/ and /χ/, as well as contrastive /ʕ/ and /ʁ/, while in Hebrew both /ħ/ and /χ/ are the same. Old Aramaic includes the sound /q/ as in /arqa/ 'earth', while it changed to /ʕ/ in other Aramaic dialects, with the Semitic sound /dˤ/ changing into /q/ in Old Aramaic and to /ʕ/ in other Aramaic dialects (Alsohaimi, 1995 p. 35). One of the characteristics of the Semitic languages is that they all include guttural *Horoof alhalq wa litbaq*, pharyngeal and pharyngealised sounds. Alsohaimi (1995) reports the phenomenon of sound substitution 'alebdal' *[ʔalʔɪbaːl]*, which has been studied by many Arab grammarians, who have defined 'alebdal' *[ʔalʔɪbaːl]* as the use of one sound in place of another in the same position of the same word due to a phonetic similarity that the two sounds share. He reports Ibn Jenni, who stated that sound substitution is common in Arabic.

However, the place of articulation of the substituted sounds must be shared with, or closely-related to that of their substitutes. For example, /d, tˤ, t/ and /ð, ðˤ, θ/ as well as /h, ʔ/ and /n, m/ every set share the same place of articulation. Although /sˤ/ and /dˤ/ are both pharyngealised and alveolar sounds, but they are not similar, since /sˤ/ is a fricative and /dˤ/ is a stop meaning that they differ from each other in their manner of articulation. The sound substitution is conditioned on the alternated or substituted sounds being similar or close in regard to their place of articulation or their manner of articulation.

5.2.1 The alternation of uvular segments in Gulf dialects of Arabic

The literature on the /q/ and /ʁ/ alternation is scarce. However, diachronically, the uvular stop, /q/, was at some early stage the underlying representation of [g]. Though, this need not be the case synchronically, as explained below. Arabic /q/ is inherited from Proto-Semitic and unconditional /q/ → [g] substitution is not a recent phenomenon (Martinet, 1959 p. 99; Mustafawi, 2006 p.13; Al-Wer, 2004). Al-amadidhi (1985) reports that "*/q/ was first fronted to produce the voiced velar stop [g]... at some later stages this /g/ was fronted to yield the affricated [dʒ]*". The first change is suggested to have occurred around the eighth or ninth century, but no date is given for the second change (Al-amadidhi, 1985, p. 29), since the substitution, /q/ → [g], occurred a long time ago, as reported by different scholars (about twelve centuries). In other words, [q] did not surface as a variant of [g] in these varieties for more than eleven centuries, which clearly argues against /q/ being the UR of [g]. Although, some scholars still refer to /q/ as the UR because of the writing system in which /g/ has no representation.

The uvular alternation between /q/ and /ʁ/ has been reported in the literature by several scholars as merely observations. They have observed and reported such alternation in GA dialects, i.e. Kuwait, Bahrain, UAE, Qatar and Oman. Their remarks, and analyses of this alternation phenomenon present three

assumptions. First, since no alternation pattern has been found, the phenomenon is considered a free variation (Matar, 1969; Bukshaisha, 1985; Al-amadihi, 1985; Al-Sulaiti, 1993; Aldaihani, 2014). Second, in religion-related and classical words the /q/ sound is preserved and does not alternate with /ʁ/ (Al-amadihi, 1985; Hussain 1985). Third, the alternation is governed, but purely by social factors, i.e. age, gender, education and style. There are no phonological factors that stipulate the alternation (Mustafawi, 2006; Taqi, 2010; Holes, 2016).

The remainder of the chapter provides phonological evidence that the alternation in the uvular segments /q/ and /ʁ/ is not a free variation phenomenon in HA. In fact, there is a pattern, and phonological rules to govern this alternation in specific environments in which one segment is preferred to the other on the surface form. These rules are illustrated and the collected data are then analysed within the HS-OT approach.

5.3 The alternation of uvular segments /q/ and /ʁ/ in HA

The alternation phenomena, /ʁ/ → [q] and /q/ → [ʁ], show both fortition and lenition processes. However, these processes differ from the one step mapping that has been presented by other researchers in the literature (Hock, 1991; Kirchner, 2001, 2004, 2013; Ito, 2001 – to mention a few).

Lenition is a phonological phenomenon that has been reported in the Arabic dialects of Eastern Arabia. One of the most reported phenomena is the lenition of the affricate /ʤ/ to the glide [j] (Johnstone, 1965, 1967; Maṭar, 1969, 1985; Al-amadidhi, 1985; Al-Sulaiti, 1993). A less reported, yet briefly mentioned phenomenon is the lenition of the stop /q/ to the fricative /ʁ/, specifically in the Gulf Arabic dialects (Johnstone, 1965, 1967; Maṭar, 1969, 1985; Al-amadidhi, 1985; Al-Sulaiti, 1993). The lenition process involving spirantisation of /q/ to [ʁ] can be analysed using 'Harmonic Sonorancy', a universal constraint meaning that, in the vicinity of sonorants, segments tend to undergo a sonority assimilation process, in

which a segment becomes more sonorous (Vijayakrishnan 2003).

Previous studies refer to the lenition of /q/ to [ʁ] as applying to less classical Arabic words and less religious words, with religion-related words and more classical words being assumed to preserve the /q/ sound rather than undergoing the lenition to [ʁ], thus resisting the lenition process (Al-amadidhi, 1985 p. 158; Hussain, 1985). This is the case even if words with /q/ that are commonly and widely used in the everyday dialect exhibit this alternation. Another restriction on the lenition of /q/ to [ʁ] is governed purely by social factors, i.e. education and style.

Both the lenition of /q/ to [ʁ] and the fortition of /ʁ/ to [q] are stated to be in free variation and no pattern is found in the dialects covered in previous studies in BA (Maṭar 1984), QA (Bukshaishah, 1985; Alamadidhi, 1985; Alsulaiti, 1993), EA (Alamadidhi1985) and KA (Alamadidhi, 1985 and Aldaihani, 2014).

Nevertheless, in this analysis, the alternation of /q/ to [ʁ] is considered a lenition process, while the alternation of /ʁ/ to [q] is considered a fortition process, with a consistent pattern being obtained from the HA data collected. Thus, in a certain environment, one segment appears while an alternate segment appears elsewhere. Most of the studies that have tackled different alternation phenomena focus on the statistical aspect of the alternation to establish the frequency of a variable output depending on the performance of the speakers. The use of HS-OT in the study, however, provides a pattern by which such alternation gradually occurs and develops within the intermediate derivational steps until the final outputs are reached. The alternation that the uvular segments /q/ and /ʁ/ undergo has been reported in the literature as being restricted to religious terminology, as restricted by different social factors such as in formal speech, and as a free variation phenomenon. Although there are discrepancies, cases in which the uvular segments /q/ and /ʁ/ are maintained must be identified first, as seen below, in order to map the pattern of the alternating uvular segments under examination in HA from a HS-OT perspective.

5.3.1 Preserving /q/ in HA

From the data collected in this study, it is observed that the voiceless uvular stop /q/ is still active in the HA dialect, and not only for religious reasons or for religious words, as has been suggested in previous research, especially for the voiceless uvular stop /q/. There are colloquial and widely used words in HA that preserve the segment /q/, showing no alternations. However, there are cases in which /q/ exhibits alternations as a result of undergoing different phonological processes, such as voice assimilation, MOA assimilation, POA assimilation,[57] or in lexicalised forms in HA, in which /q/ is considered the underlying form. Out of 2,500 tokens collected, several examples exhibit the voiceless uvular stop /q/ alternations pattern. The cases of /q/ alternation in HA are listed below.

The examples in (5-2) below show how the voiceless uvular stop /q/ is preserved in different environments in HA: a. in the vicinity of voiceless non-pharyngealised obstruent segments; b. in the position adjacent to the pharyngealised segments /tˤ, sˤ, ðˤ/; and c. in the position adjacent to the back vowels /ɑ/ and /ʉ/.

Example 5-2 No change of [q] in HA

a.	**/q/ adjacent to voiceless obstruent segments**		
	/mʉqtaraħ/	[mʉqtaraħ]	‘suggestion’
	/ʔitqɑːn/	[ʔitqɑːn]	‘perfection’
	/wɑqħɑ/	[wɑqħɑ]	‘shameless’
b.	**/q/ adjacent to a pharyngealised segment**		
	/ʔɑqsˤʉrˤ/	[ʔɑqsˤʉrˤ]	‘truncated’
	/taqðˤɨ/	[tɑqðˤɨ]	‘compensate’

[57] The POA assimilation processes are beyond the scope of this research and are left for future research.

	/bˤɑtˤrˤiːq/	[bˤɑtˤrˤiːq]	‘penguin’
	/mˤɑqtˤʉːrˤɑ/	[mˤɑqtˤʉːrˤɑ]	‘trailer’
	/qɑjsˤɑrˤ/	[qɑjsˤɑrˤ]	‘Caesar’
	/qɨsˤsˤɑ/	[qɨsˤsˤɑ]	‘story’
c.	**/q/ adjacent to a back vowel /ɑ/ and /ʉ/**		
	/qʉdra/	[qʉdra]	‘ability’
	/qɑsam/	[qɑsam]	‘swear’
	/wˤɑqʉːrˤ/	[wˤɑqʉːrˤ]	‘dignified’
	/mʉqɑːrˤɑnah/	[mʉqɑːrˤɑnah]	‘comparison’
	/qɑrˤɑːrˤ/	[qɑrˤɑːrˤ]	‘decision’
	/fˤɑqɨːrˤɑ/	[fˤɑqɨːrˤɑ]	‘poor’

The uvular /q/ is kept intact in the environments presented in examples (5-2). In the first environment (a.) /q/ is in the vicinity of voiceless obstruent segments: /t/ and /ħ/ with which /q/ shares the [-voice] feature specification. In the second environment (b.) /q/ is in the vicinity of pharyngealised segments: /tˤ, ðˤ, sˤ/ with which as a stop segment, /q/ shares an effort quality during the articulation process similar to that of the pharyngealised segments and /q/ shares a closer point of articulation than /ʁ/. The following segments are ordered in the sense of their point of articulation from front to back: /ðˤ/- /tˤ/- /sˤ/- /q/- /χ/- /ʁ/ (Zawaydeh, 1999). In addition, /q/ is suggested to be the emphatic counterpart of /k/ by some scholar such as (Kahn, 1976). Therefore, characteristics that /q/ shares with the pharyngealised segments makes it preferred in the vicinity of the pharyngealised segments rather than /ʁ/. In the third environment (c.) /q/ is in the vicinity of back vowels in the onset position, a strong position, this forces the preference of the stronger

segment /q/ as the voiceless stop. In addition, the examples in (5-2) support the introduction of the constraint PRESERVE /q/. This constraint is introduced here to ensure that no changes apply to the input /q/. The definition of the constraint is given below:

PRESERVE /q/

Assign one violation mark when an input /q/ is not preserved in the output.

5.3.2 Voicing /q/ to [ɢ] in HA

The examples in (5-3) show the environments in which /q/ surfaces as the voiced counterpart [ɢ]. /q/ undergoes a voice assimilation process in which /q/ alternates from the voiceless uvular stop /q/ into the voiced uvular stop [ɢ] when it occurs in the vicinity of voiced segments in HA, /ʕ/, /b/, /l/ and /m/ as shown in the examples below, in a consonant cluster or in a CC sequence adjacent to a voiced segment, whether in the onset, or in word-medial or/and coda positions. For example, /bˤqɑrˤɑ/→ [bˤɢɑrˤɑ] 'a cow', /lˤʉqmˤɑ/ [lˤʉɢmˤɑ] 'a bite' and /bˤʉqʕɑ/→ [bˤʉɢʕɑ] 'a stain' respectively.

Example 5-3: Voicing of /q/ to [ɢ] in HA

Input	**Output**	**Gloss**
/ʕqɑːlˤ/	[ʕɢɑːlˤ]	'male head piece'
/bˤʉqʕɑ/	[bˤʉɢʕɑ]	'a stain'
/bˤqɑrˤɑ/	[bˤɢɑrˤɑ]	'a cow'
/χɑlˤq/	[χɑlˤɢ]	'creatures'
/qmˤɑːʃ/	[ɢmˤɑːʃ]	'textile'
/lˤʉqmˤɑ/	[lˤʉɢmˤɑ]	'a bite'

As a result of the voice assimilation process, the alternation occurs in this case as /q/ copies the [+voice] feature specification of the adjacent segment and surfaces as [ɢ]. In this case, /ɢ/ is allophonic. Therefore, in the adjacency to the voiced segments /ʕ/, /b/, /l/ and /m/ in the examples above, /q/ surfaces as the allophonic [ɢ] in HA.

5.3.3 Voicing and spirantisation from /q/ to [ʁ] in HA[58]

The examples in (5-4) illustrate an alternation from the voiceless uvular stop /q/ to the voiced uvular fricative [ʁ]. This entails that two phonological processes are in action: voicing and spirantisation. First, in the voicing the change of the segment /q/ in the voice feature specification from being a voiceless segment: [-voice] to being a voiced segment [+voice]. Then, spirantisation the change of the manner of articulation of from being a stop with the continuant feature specification from being [-cont] to being a fricative segment [+cont].

Example 5-4: Voicing + spirantisation of /q/ to [ʁ] in HA

Input	**Output**	**Gloss**
/tɑqr.i:ban/	[tɑʁ.ri:ban][59]	'almost'
/fˤɑq.rˤɑ/	[fˤɑʁ.rˤɑ]	'a paragraph'

The only instance in which /q/ alternates with /ʁ/ is in word-medial position in HA where /ʁ/ is in the coda of the first syllable followed by /r/ in the onset of the second syllable. Whether the associated vowels are plain or pharyngealised /ɨ/ or /ɑ/, the adjacency of the two segments /q/ and /r/ triggers the

[58] Given that /q/ and /ʁ/ are uvular segments, the vowels in their vicinity are the back pharyngealised vowels /ɑ/, /ʉ/ and /ɨ/.
[59] To the best of my knowledge, Al Taisan is the first to provide this case (2019).

change from /q/ to [ʁ] as a result of sonority assimilation processes.[60] First, /q/ copies the [+voice] feature from /r/, then it assimilates to the manner of articulation feature [+cont]. Spirantisation of a stop segment to a fricative is reported in the literature as a sonority assimilation process in which a segment becomes more sonorant in the vicinity of a sonorant segment, the trill /r/ in example (5-4) /tɑq.riːban/→ [tɑʁ.riːban] 'almost', satisfying the universal constraint 'Harmonic Sonorancy' (Vijayakrishnan, 2003). When the trill /r/ is adjacent to an emphasis trigger be it pharyngealised or uvular segment, or even by itself, it exhibits a certain quality of vowel lowering closer to that triggered by the uvular segment /ʁ/, to the point where scholars suggest that the uvular and the trill are both approximants. As such, it is hard to distinguish them on a spectrogram reading. Therefore, when /q/ occurs in the vicinity of /r/ it alternates to [ʁ]. Whereas [ʁ] is preserved in the vicinity of [r] (Freeman, 2019). This concept applies in the HA examples presented in in 5-4 and 5-5 respectively.

5.3.4 Preserving /ʁ/ in HA

Although /ʁ/ mostly alternates to [q] in the data from HA, it also shows that the voiced uvular fricative /ʁ/ is preserved in few words in a certain environment as illustrated in the examples in (5-5) below:

Example 5-5: No change of [ʁ] in HA

Input	**Output**	**Gloss**
/taʁrˁiːd/	[taʁrˁiːd]	'tweet'
/mˁɑʁrˁɨb/	[mˁɑʁrˁɨb]	'a paragraph'

[60] During the data collection interviews, one of the participants produces a velar-like fricative in the adjacency of the front vowels /i/ and /a/.

The environment that enforces the voicing and spirantisation of the underlying /q/ to [ʁ], as presented in example (5-4) above, is the same environment that preserves the underlying /ʁ/ in HA, as presented in example (5-5). When /ʁ/ occurs in a word-medial position in the coda of the first syllable and with /r/ in the onset of the second syllable, then no change applies to /ʁ/. It is worth mentioning here that a pharyngealisation / uvularisation process applies whereby the trill /r/ is pharyngealised to [rˤ], and as such the distinction between the trill /rˤ/ and the fricative /ʁ/ is difficult to achieve since they both share the feature [+cont]. Therefore, these two segments harmonise together and no further harmonic improvements are needed. In the words /taʁrˤɨːd/ 'tweet' and /mɑʁrɨb/ 'sunset' in example (5-5), /ʁ/ is kept intact when it occurs in a CC sequence associated with the sonorant /r/ (Vijayakrishnan, 2003; Freeman, 2019). However, /ʁ/ surfaces as [q] everywhere else in HA, as introduced in the next section.

5.3.5 The alternation from /ʁ/ to [q] in HA

The alternation from /ʁ/ → [q] in HA is a fortition process which forces the uvular fricative /ʁ/ to surface with a stronger uvular variable, such as a uvular stop [q], in certain environments and positions. This alternation involves two phonological processes, i.e. devoicing and loss of the manner of articulation specification of the /ʁ/. The examples in (5-6) show the environments in which the underlying /ʁ/ surfaces as [q] in HA.

Example 5-6: /ʁ/ to [q] in HA

a.	**/ʁ/ in consonant clusters or CC sequences**		
	/ʁlɨgɑ/	[qlɨɕɑ]	'depression'
	/lʁʉːd/	[lqʉːd]	'jowls'
	/sˤɑmˤʁ/	[sˤɑmˤq]	'glue'

	/ʁtˤɑrˤrˤ/	[qtˤɑrˤrˤ]	‘male head wear’
b.	**/ʁ/ in a pharyngealisation environment**		
	/ðˤɑʁtˤ/	[ðˤɑqtˤ]	‘pressure’
	/bˤʉʁðˤ/	[bˤʉqðˤ]	‘detest’
	/sˤʁɨːrˤ/	[sˤqɨːrˤ]	‘little’
	/ʁɑmˤiːðˤɑ/	[qɑmˤiːðˤɑ]	‘regrettably’
c.	**/ʁ/ in onset position**		
	/ʁɑlɑ/	[qɑlˤɑ]	‘precious’
	/ʁɨːrˤɑ/	[qɨːrˤɑ]	‘jealousy’
	/ʁɑːzi/	[qɑːzi]	‘warrior’
	/ʁʉrˤfˤɑ/	[qʉrˤfˤɑ]	‘room’
	/ʁɑbˤrˤɑ/	[qɑbˤrˤɑ]	‘irritant’

Three environments are introduced in (5-6). First, the examples in (5-6a) show that the occurrence of /ʁ/ in a consonant cluster or CC sequence environment forces the alternation to [q], satisfying a higher ranked constraint. When /ʁ/ is adjacent to the lateral segment /l/ in a word-initial consonant cluster in example (5-6a), it changes to [q] as /l/ is a sonorant segment, as in /ʁlˤɨɕɑ/ → [qlˤɨɕɑ] ‘depression’. /r/ and /l/ are both liquids, but they differ in the specification of the feature [±cont], with /r/ being [+cont] but /l/ [-cont]. The occurrence of /r/ in a CC sequence with /ʁ/ preserves [ʁ], as shown in the examples in (5-5), whereas the occurrence of /l/ in a CC sequence with /ʁ/ triggers the alternation from /ʁ/ to [q].

Second, the examples in (5-6b) show the occurrence of /ʁ/ in the vicinity of the pharyngealised segments /tˤ, ðˤ, sˤ/. This fortition process is based on articulator effort in the vicinity of pharyngealised segments during articulation. On one hand, pharyngealised segments are complex and require more effort

during the articulation process. The uvular segments /q, ʁ/, on the other hand, are complex too. However, the uvular voiceless stop is the strongest and requires more force and effort during articulation than the voiced uvular fricative /ʁ/. As a result, in the vicinity of pharyngealised segments in which alternation occurs, [q] is the surface form satisfying the constraint EFFORT.

Third, (5-6c) shows /ʁ/ in word-initial position. To deal with the phenomenon of fortition whereby /ʁ/ becomes [q], the constraint that determines the well-formedness of the onset depends on its sonority. The less sonorous the segment is, the more well-formed the onset. Therefore, *M/ʁ is a constraint that penalises the occurrence of /ʁ/ in onset and coda positions of a syllable.

5.3.6 The case of the velar /g/ in HA

The voiceless uvular stop /q/ had already changed to [g] centuries ago, as reported in the literature and recently for one of the GA dialects, Qatari Arabic, by Mustafawi (2006). This means that /g/ surfaces in a fronting environment and adjacent to the front vowels /i/ and /a/, whereas /ɢ/ surfaces as an allophone in the pharyngealised environment and adjacent to the back vowels /ɑ/ and /ʉ/. As such, /g/ is considered the underlying form in some of the HA data given in this study. This contradicts what has been suggested by other researchers, who report a total substitution of /q/ by [g] in the Gulf dialects, while at the same time considering /q/ to be the underlying form for all instances of [g].

Example 5-7: /g/ → [ɢ] in HA

Input	**Output**	**Gloss**
/gʉmˤɑrˤ/	[ɢʉmˤɑrˤ]	‘moon’
/gɑːrˤɑ /	[ɢɑːrˤɑ]	‘historical mountain’
/ʃɨgɑfˤ/	[ʃɨɢɑfˤ]	‘pieces’

/gɑrˤɑʕ/	[ɢɑrˤɑʕ]	‘squash’
/gɑːmˤ/	[ɢɑːmˤ]	‘he rose’
/gɨðlah/	[ɢɨðˤlah]	‘bangs’
/gɨmt/	[ɢɨmˤt]	‘I stood up’

The examples in (5-7) show that when the voiced velar stop /g/ is adjacent to the back vowels /ɑ/ and /ʉ/, which are referred to in the literature as pharyngealisation vowels, then /g/ surfaces as [ɢ]. It is worth noting that the examples in (5-7) also appeared by some speakers with velar /g/ and the non-pharyngealisation vowels, i.e. /a/ and /u/. However, the majority of the participants: 37 out of 50 exhibit an emphasis quality in their recordings of these words.

The HA examples presented in (5-8) are almost minimal pairs. They show that the uvular segments /q, ʁ, χ/ and the velar /g/ are phonemic in the dialect. However, the examples in (5-3) and (5-7) above illustrate that the voiced uvular stop [ɢ] is an allophonic variety of /q/ due to a voicing process, and an allophonic variety of /g/ in a pharyngealisation environment in which the underlying /g/ surfaces as [ɢ].[61]

Example 5-8: /q/, /ʁ/, /χ/ and /g/ as phonemic in HA

	Input	**Output**	**Gloss**
/q/	/qɑʃˤ/	[qɑʃˤ]	‘straw’
	/qɑd/	[qɑd]	‘figure’
/ʁ/	/ʁɑʃˤ/	[ʁɑʃˤ] / [qɑʃˤ][62]	‘cheat’

[61] It should be noted that detailed analysis of the velar /g/ in HA is beyond the scope of this study and is left for further research.
[62] To clarify this example, as a preserved /ʁ/ may ONLY occur in formal situation. However, after careful and further discussion with speakers of the same dialect, the output of /ʁɑʃˤ/ is actually [qɑʃˤ] in HA.

	/ʁɑd/	[ʁɑd] / [qɑd]	‘to feed’
/χ/	/χɑʃˤ/	[χɑʃˤ]	‘hide’
	/χɑd/	[χɑd]	‘cheek’
/ɡ/	/ɡaʃˤ/	[gaʃ]	‘luggage’
	/ɡad/	[gad]	‘size’

Since some of the examples of /g/ from the data collected are affricated and fronted from velar to alveolar position [ʤ] adjacent to the high vowel /i/ in HA, such as in /gidir/ → [ʤidir] ‘pot’ and /firiːg/ → [firiːʤ] ‘team’, then it is plausible that, diachronically, the uvular /q/ had already been substituted for some lexical items by [g] long ago. However, synchronic data from HA prove that both segments /q/ and [g] are active segments in the dialect and both segments are, therefore, considered UR in this study for several lexical items which have [q] and [g] in the output forms invariably. This is supported by the existence of the invariable examples of HA data. This also coincides with reported phenomena in related Gulf and other Arabic dialects in the literature regarding the segmental change from the uvular /q/ to the velar [g] in the vicinity of the high front vowel /i/ (Mustafawi, 2006; Bellem, 2007; Watson, 1996a).

Before moving to the analysis of the uvular alternations in HA from a HS-OT perspective, the following section presents a brief reference to similar alternation phenomena in two languages: the segmental harmony in Kazakh (Kubaeva, 2007; Aigul et al., 2015) and the stop-spirant variation in Spanish (Harris, 1969; Smith, 2004).

5.4 Pattern of alternation in other languages

The Kazakh language exhibits vowel harmony referred to as ‘*hard vowels’* and ‘*soft vowels’*, which seem to correspond to front and back vowels. In any single word along with its suffixes, either hard vowels

occur, or soft vowels, but never a mixture of the two types. The segmental system in Kazakh exhibits the phenomenon of segmental alternation, in which front vowels /œ, ʉ, æ, ɪ/ occur in the vicinity of velar consonants /k, g/, while back vowels /u̟ʊ̟, ʊ, ɑ, ə/ appear in the vicinity of uvular consonants /q, ʁ/ and the glottal /h/. There is also a correspondence between the hard and soft sounds such that, among the vowels, /u̟, ʊ/ alternate with /œ/, /ʊ/ with /ʉ/, /ɑ/ with /æ/, and /ə/ with /ɪ/, while among the consonants, /q/ alternates with /k/, /ʁ/ with /g/, and /h/ with Ø (Kubaeva, 2007; Aigul et al., 2015).

The phenomenon of segmental alternation is widely reported in Spanish, in which stop segments /b, d, g/ are spirantised to the allophonic fricatives /β, ð, ɣ/ or approximants /β̞, ð̞, ɯ̟/ in certain contexts as a type of lenition process. This phenomenon is referred to as 'stop-spirant variation' (Harris, 1969; Smith, 2004). According to Harris (1969) "the voiced stops become nonstrident continuants after obstruents, continuants and noncontinuant sonorants that disagree in terms of the feature [coronal]" (Harris, 1969, pp.39-40). Although other scholars, such as Barlow (2003), assume the phenomenon is actually driven by a fortition process instead in a phrase-initial context, i.e. the onset position (Barlow, 2003, p.12).

HA and Kazakh exhibit similar pattern of the interaction amongst the segments., The pattern of alternations between the vowels and the consonants in the sense that in the vicinity of uvular segments /q, ʁ/ the back vowels 'hard vowels'/u̟ʊ̟, ʊ, ɑ, ə/ occur whereas the front vowels 'soft vowels' /œ, ʉ, æ, ɪ/ occur in the vicinity of the velar consonants /k, g/. However, they differ in the specific phonetic characteristics of the vowels. In addition, they also differ in the alternating segments between the two dialects. HA exhibits the alternation between the uvular segments /q/→ [ʁ], /q/→ [ɢ] and /ʁ/→ [q], which means it is an alternation in voicing and manner of articulation but within the same place of articulation. Whereas the reported alternating segments in Kazakh are /q/ with /k/ and /ʁ/ with /g/ and /h/ with /Ø/ exhibit a fronting place of articulation process from uvular to velar in the case of /q/ with /k/ and /ʁ/ with /g/ or total

deletion in the case of /h/ with /Ø/. The general concept of segmental harmony persists in both dialect though HA and Kazakh.

On the other hand, the stop-spirant alternation phenomenon in Spanish is similar to HA in the sense that the alternation is triggered by a positional factor, onset position, and the change in the alternating segments is minimum and represented in terms of specification of the distinctive features of the segments.

The following section presents the analysis of the alternation of the uvular segments /q/ and /ʁ/ in HA from the HS-OT perspective. HS-OT (MacCarthy, 2000) is the derivational version of OT (Prince & Smolensky, 1993/2004), which will prove sufficient in analyzing such a complicated phenomenon with several phonological processes interacting during the application of this alternation phenomenon.

5.5 Uvular alternations from a HS-OT perspective in HA

The HA uvular segment alternations phenomenon presented in this research is analyzed within HS-OT, which entails gradual harmonic changes through several derivational steps until convergence is achieved. These harmonic changes include distinctive feature change, i.e. the linking, delinking and spreading of features since both of the alternating segments /q/ and /ʁ/ are uvular and obstruent (Smith, 2007; Gordon, 2004).

To the best of my knowledge, this is the first research to use the HS-OT framework in analyzing an alternation phenomenon. It characterizes HS-OT's ability to resolve certain phenomena by anticipating the intermediate derivational stages up to the optimal output. This section provides analysis of complicated examples that include an interaction between several phonological processes in the uvular alternation in HA, i.e. voice assimilation, emphasis spread: pharyngealisation or uvularisation and manner of articulation assimilation processes. In section 5.3 and its subsections, cases in which the uvular segments /q/ and /ʁ/ are both preserved and alternated are presented along with cases in which the velar /g/ alternates to [ɢ]

in HA. However, this section focuses on analyzing those cases that exhibit the alternation between /q/ and /ʁ/ in particular.

Cases of uvular voice assimilation processes have been presented in chapter four (pp. 134-139 & 142-144), in which the voice assimilation process involving the counterpart uvular segments, /q, ɢ/ and /χ, ʁ/, are analyzed within two intermediate derivational steps. However, other obstruent uvular segment alternations, /ʁ/ → [q] and /q/ → [ʁ], entail having more derivational steps that include voice assimilation and manner of articulation assimilation processes.

As explained earlier in chapter 4, in a voice assimilation process, the unspecified [voice] feature is represented by the symbol /Ɐ/. This represents the intermediate output in which the segment loses the specification for its original voice feature [±voice]. However, in a manner of articulation assimilation process, in the intermediate stage of the loss of the [cont.] feature for uvular segments in HA /q, ɢ, χ, ʁ/ is represented in this study by the symbol /Ɋ/. Since the feature [±cont.] links uvular obstruent segments, the symbol /Ɋ/ is established for mannerless uvular segments. The gradual harmonic improvements and derivational steps for HA manner of articulation assimilation, as well as the voice assimilation with the features of the uvulars, /q/ and /ʁ/, are shown in Figure 5-1 below:

Figure 5-1: Voice and manner of articulation assimilation

/q/ → /Ɐ/ → /ɢ/ → /Ɋ/ → [ʁ]
/ʁ/ → /Ɐ/ → /χ/ → /Ɋ/ → [q]

5.5.1 Case (1): Voicing and spirantisation from /q/ to [ʁ] in HA

The examples in (5-9) exhibit voicing and spirantisation from voiceless uvular stop /q/ to the voiced uvular fricative [ʁ] in the position adjacent to the liquid segment /r/ in HA. It is a hybrid example in which three phonological processes are involved: voice assimilation, emphasis spread and manner of articulation assimilation within the HS-OT framework.

Example 5-9: Voicing and spirantisation from /q/ → [ʁ] in HA

Input	**Output**	**Gloss**
/tɑqriːb/	[tɑʁriːbˁ]	‘guess’
/fɑqra/	[fˠɑʁrˁɑ]	‘a paragraph’

The examples in (5-9) above illustrate the environment in which /q/ surfaces as [ʁ], namely word-medial coda position followed by the trill segment /r/ in the onset of the second syllable. The alternation of /q/ to [ʁ] involves three phonological processes. First, /q/ undergoes voice assimilation in the vicinity of the voiced segment /r/. Second, emphasis spread occurs. Third, the manner of articulation assimilation involves a change in the specification of the manner feature of the target segment /q/ triggered by the trill /r/.

These processes occur gradually and with one harmonic change in each step. The HS-OT constraints and their definitions for the voice assimilation process and the emphasis spread process are reintroduced for convenience, while the constraints and definitions for the manner of articulation assimilation process are introduced to explain the pattern of uvular segment manner of articulation assimilation in HA:

AGREE [VOICE]

The uvular segment in a CC sequence must agree with the adjacent segment for the feature [voice] at the lexical level.

HAVE VOICE

Assign one violation mark for every segment that has no voice specification.

NOLINK [VOICE]

Assign one violation mark for linking the unspecified [voice] coda /ɣ/ with the onset in the voice feature.

MAX-IO [VOICE]

Let the nasal tier = p_1 p_2 p_3…p_n and the output Voice tier = p_1 p_2 p_3…p_n.

Assign one violation mark for every p_x that has no corresponding p_y (McCarthy, 2008b).

SPREAD [RTR]

Every feature [RTR] is linked to every segment within a word (Padgett, 1997).

IDENT-IO [RTR]

The output segment and its input correspondent must have identical values for the feature [RTR] (McCarthy and Prince, 1995).

AGREE [CONT]

The uvular segment in a CC sequence must agree with the adjacent segment for the feature [cont] at the lexical level.

HAVE MANNER

Assign one violation mark for every segment that has no manner of articulation specification.

MAX-IO [CONT]

Assign one violation mark for every p_x that has no corresponding p_y in the [cont] feature.

NOLINK [CONT]

Assign one violation mark for linking the unspecified [cont] coda /Ȼ/ with the onset or coda cluster in the [cont] feature.

The following Tableau 5-1 and the steps (5-1-a) – (5-1-f) illustrate the HS-OT representation of the alternation from /q/ to [ʁ] triggered by the trill /r/ in the word /faqra/ → [fˤɑʁrˤɑ] ‘a paragraph’ in HA. This mapping from the underlying/ the input form to the final surface form occurs in six derivational steps.

Tableau 5-1: HS-OT analysis of /fɑqra/ → [fˤɑʁrˤɑ]

(5-1-a) Step 1

/fɑqra/	AGREE [VOICE]	MAX-IO [VOICE]
(1) Voice Assimilation /fɑqra/ → [fɑɣra]		
a. /fɑqra/	*!	
☞ b. /fɑɣra/		*

The first phonological process is represented in the first step. It shows the voice assimilation process in which candidate (a) /fɑqra/ loses since it violates the highly ranked constraint AGREE [VOICE] because the voice feature specification for /q/ is [-voice] while the adjacent segment, the trill /r/, has the voice feature specification [+voice]. Candidate (b) /fɑɣra/ is the winner at this step as it loses its voice feature specification. The lack of the voice feature specification means the feature value is empty and the

constraint AGREE [VOICE] is satisfied as such. The winning output from the first derivational step is inserted as the input to pass through Eval in the next derivational step.

(5-1-b) Step 2

/fɑⱯra/	AGREE [VOICE]	HAVE VOICE	MAX-IO [VOICE]	NOLINK [VOICE]
(2) Voice Assimilation /fɑⱯra/ → [fɑɑra]				
a. /fɑⱯra/		*!		
☞b. /fɑɑra/				*

The voice assimilation continues in the second step which demonstrates the addition of two constraints HAVE VOICE and NOLINK [VOICE] in order for the next step to occur. To assert a [voice] feature specification, the constraint HAVE VOICE must outrank MAX-IO [VOICE]. Whereas NOLINK [VOICE] is ranked lower in the constraint hierarchy. As a result, candidate (a) /fɑⱯra/ is ruled out and candidate (b) /fɑɑra/ is the optimal output. Although /fɑɑra/ violates the lower ranked constraint NOLINK [VOICE] since the alternated segment in the optimal output in this step is linked in the [voice] feature to the adjacent [+voice] feature of /r/, but it satisfies a higher constraint HAVE VOICE by having a specified [+voice] feature. A dotted line is used to represent the ranking between the two constraints MAX-IO [VOICE] and NOLINK [VOICE]. No conflict can be established since their ranking with regard to each other will not affect the result. The output of this step is inserted as the input in the next derivational step.

(5-1-c) Step 3

/fɑɢra/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
(3) Emphasis spreads /fɑɢra/ → [fˤɑɢrˤɑ]						
a. /fɑɢra/			*!			
☞b. /fˤɑɢrˤɑ/						*

The third step shows the emphasis spread process is asserted by the addition of two constraints SPREAD [RTR] and IDENT-IO [RTR]. SPREAD [RTR] is ranked higher than MAX-IO [VOICE] to ensure the application of the emphasis spread process in which the emphasis spreads from the uvular /ɢ/ in /fɑɢra/ to cover the entire word /fˤɑɢrˤɑ/. The spread of emphasis is considered as one single harmonic improvement throughout the word, to avoid repetition of the emphasis spread steps of individual segments. Therefore, candidate (a) loses as it does not show the emphasis spread even though it satisfies the lowest ranked constraint IDENT-IO [RTR]. Whereas candidate (b) wins showing an emphasized word [fˤɑɢrˤɑ]. After that, /fˤɑɢrˤɑ/ is inserted as the input in the next derivational step.

The next phonological process to apply is the manner of articulation assimilation. It is represented in the fourth derivational step in tableau 5-1-d below. This step also shows the addition of two constraints in order for the manner of articulation assimilation to occur: the markedness constraint AGREE [CONT] and the faithfulness constraint MAX-IO [CONT]. AGREE [CONT] is ranked higher than MAX-IO [VOICE] to ensure the order in which the processes apply for this example. Whereas MAX-IO [CONT] is ranked the lowest in the hierarchy as the faithfulness constraint of the last process to apply.

(5-1-d) Step 4

/fˤɑɢrˤɑ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	AGREE [CONT]	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]	MAX-IO [CONT]
(4) MoA Cont. Assimilation /fˤɑɢrˤɑ/ → [fˤɑʛrˤɑ]								
a. /fˤɑɢrˤɑ/				*!				
☞b. /fˤɑʛrˤɑ/								*

Candidate (a) /fˤɑɢrˤɑ/ loses since it violates AGREE [CONT] because the uvular /ɢ/ and the adjacent segment the trill /r/ have different specification for the feature [cont], i.e. as a stop /ɢ/ has the specification [-cont], whereas the trill /r/ has the specification for the feature [+cont]. Therefore, the harmonic and the gradual derivation is to lose the specification of the feature [-cont]. Consequently, candidate (b) is the optimal output in this step since the voiced uvular stop /ɢ/ loses its specification for the feature [-cont] in /fˤɑɢrˤɑ/ and surfaces as [ʛ] in [fˤɑʛrˤɑ], violating the low ranked constraint, MAX-IO [CONT] which militates against having different corresponding inputs and outputs in the feature [cont], but satisfying the higher ranked constraint, AGREE [CONT]. After that, /fˤɑʛrˤɑ/ is inserted as an input to go through Eval in the next derivational step.

(5-1-e) Step 5

/fˤɑʛrˤɑ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	AGREE [CONT]	HAVE MANNER	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]	MAX-IO [CONT]	NOLINK [CONT]
(5) MoA Cont. Assimilation /fˤɑʛrˤɑ/ → [fˤɑʁrˤɑ]										
a. /fˤɑʛrˤɑ/					*!					
☞b. /fˤɑʁrˤɑ/										*

The manner of articulation assimilation continues in the fifth step with the addition of a manner specification constraint, i.e. HAVE MANNER, which ranked below AGREE [CONT] and higher than MAX-IO [VOICE]. Whereas NOLINK [CONT] is added as a faithfulness constraint and ranked the lowest. HAVE MANNER imposes the specification of the manner feature. Therefore, candidate (a) is ruled out since it has no specification for the feature [cont]. Consequently, candidate (b) is the optimal output, as it violates the lowest ranked added constraint NOLINK [CONT], but satisfies a higher constraint in the hierarchy. /fˤɑʁrˤɑ/ is then inserted as an input to go through Eval in the next derivational step.

(5-1-f) Step 6

/fˤɑʁrˤɑ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	AGREE [CONT]	HAVE MANNER	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]	MAX-IO [CONT]	NOLINK [CONT]
(6) Convergence /fˤɑʁrˤɑ/ → [fˤɑʁrˤɑ]										
☞a. [fˤɑʁrˤɑ]										

Tableau 5-1-f shows the convergence in the sixth step in which no additional harmonic improvements the final input /fˤɑʁrˤɑ/ can undergo. As a result, the input in this final step is the optimal output [fˤɑʁrˤɑ].

5.5.2 Case (2): Alternation from /ʁ/ to [q] in HA as a result of assimilation processes

The examples in (5-10) exhibit the alternation in HA of the voiced uvular fricative /ʁ/ to the voiceless uvular stop [q] due to its adjacency to other obstruent segments. The examples exhibit the interaction of three phonological processes: voice assimilation, emphasis spread and manner of articulation assimilation.

Example 5-10: /ʁ/ → [q] in HA

	Input	**Output**	**Gloss**
a.	/ðˤaʁtˤ/	[ðˤɑqtˤ]	‘pressure’
b.	/ʁtˤɑrˤrˤ/	[qtˤɑrˤrˤ]	‘male head wear’

The examples in (5-10) above illustrate some of the environments in which /ʁ/ surfaces as [q] in HA which are presented in detailed earlier in section 5.3. These environments include: /ʁ/ in a consonant cluster or CC sequence and /ʁ/ in the vicinity of pharyngealised segments /tˤ, ðˤ, sˤ/. It should be noted that in this case, the alternation from /ʁ/ to [q] is especially triggered by assimilation processes in which /ʁ/ assimilates to neighbouring obstruent segments, whether these are pharyngealised or plain.

Tableau 5-2 and the steps (5-2-a) - (5-2-f) below show the phenomenon of alternation from /ʁ/ to [q] in HA from a HS-OT perspective for the word /ðˤaʁtˤ/ → [ðˤɑqtˤ] ‘pressure’. The mapping from the underlying/ input form to the optimal output is mapped out in six derivational steps.

Tableau 5-2 HS-OT analysis of /ðˤaʁtˤ/ → [ðˤɑqtˤ]

(5-2-a) Step 1

/ðˤaʁtˤ/	AGREE [VOICE]	MAX-IO [VOICE]
(1) Voice Assimilation /ðˤaʁtˤ/ → [ðˤaɣtˤ]		
a. /ðˤaʁtˤ/	*!	
☞b. /ðˤaɣtˤ/		*

The first step illustrates the voice assimilation process. Candidate (a) /ðˤaʁtˤ/ is ruled out because it violates the highly ranked constraint AGREE [VOICE] by having the uvular /ʁ/ with a different [voice] feature specification compared to the adjacent consonant in the consonant cluster /tˤ/. /ʁ/ has a [+voice] feature whereas /tˤ/ has a [-voice] feature. Consequently, candidate (b) [ðˤaɣtˤ] is the winner at this step. Although it violates the low ranked constraint, MAX-IO [VOICE], by having no [voice] specification for the first segment in the coda cluster, it does not, however, violate the higher constraint, AGREE [VOICE]. The winner in this step is the input for the next derivational step.

The voice assimilation continues in the second derivational step in 5-2-b below with the addition of the [voice] feature specification constraint, i.e. HAVE VOICE, in order for the next step to occur, which outranks MAX-IO [VOICE]. The other added constraint in this step is the faithfulness constraint NOLINK [VOICE], which is ranked the lowest in the hierarchy in this step.

(5-2-b) Step 2

/ðˤaɣtˤ/	AGREE [VOICE]	HAVE VOICE	MAX-IO [VOICE]	NOLINK [VOICE]
(2) Voice Assimilation /ðˤaɣtˤ/ → [ðˤaχtˤ]				
a. /ðˤaɣtˤ/		*!		
☞b. /ðˤaχtˤ/				*

As a result, candidate (a) /ðˤaɣtˤ/ is ruled out and candidate (b) [ðˤaχtˤ] is the optimal output, since /χ/ assimilates to /tˤ/ in the voice feature specification [-voice]. Although it violates a lower constraint, NOLINK [VOICE], but it satisfies a higher constraint, HAVE VOICE. [ðˤaχtˤ] is then inserted as the input for the next derivational step.

(5-2-c) Step 3

/ðˤaχtˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]
(3) Emphasis spreads /ðˤaχtˤ/ → [ðˤɑχtˤ]						
a. /ðˤaχtˤ/			*!			
☞b. /ðˤɑχtˤ/						*

The third step shows the second phonological process to apply: the emphasis spread with the addition of the two constraints SPREAD [RTR] and IDENT-IO [RTR]. The winner is candidate (b), which shows the emphasis from the pharyngealised segments /ðˤ/ and /tˤ/ spreading to the adjacent segments in the input, /ðˤaχtˤ/, and covering the entire word [ðˤɑχtˤ], satisfying the constraint SPREAD [RTR]. The spread of emphasis is considered as one single harmonic improvement throughout the word in this step. Then, the winner /ðˤɑχtˤ/ is inserted as an input to go through Eval in the next derivational step.

(5-2-d) Step 4

/ðˤɑχtˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	AGREE [CONT]	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]	MAX-IO [CONT]
(4) MoA Cont. Assimilation /ðˤɑχtˤ/ → [ðˤɑɛ̆tˤ]								
a. /ðˤɑχtˤ/				*!				
☞b. /ðˤɑɛ̆tˤ/								*

The fourth step illustrates the third process in the phonological derivations for this example, which is the manner of articulation assimilation. This step shows the addition of two constraints in order for this

process to occur: AGREE [CONT] and MAX-IO [CONT]. Candidate (a) loses since it violates AGREE [CONT]. The reason is that the specification of the pharyngealised stop /tˤ/ in the [cont] feature is [-cont], whereas the specification of the uvular fricative /χ/ is [+cont]. Therefore, candidate (b) [ðˤɑC̈tˤ] is the optimal output in this step, since the voiceless uvular fricative /χ/ loses its specification for the feature [+cont] to the empty/ unspecified [cont] feature [C̈]. Although [ðˤɑC̈tˤ] violates the low ranked constraint, MAX-IO [CONT], it satisfies a higher ranked constraint, AGREE [CONT]. Then /ðˤɑC̈tˤ/ is inserted as the input for the next derivational step.

(5-2-e) Step 5

/ðˤɑC̈tˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	AGREE [CONT]	HAVE MANNER	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]	MAX-IO [CONT]	NOLINK [CONT]
(5) MoA Cont. Assimilation /ðˤɑC̈tˤ/ → [ðˤɑqtˤ]										
a. /ðˤɑC̈tˤ/					*!					
☞b. /ðˤɑqtˤ/										*

In order for the manner of articulation assimilation to continue in the fifth step, two constraints, HAVE MANNER and NOLINK [CONT] are added to the constraint hierarchy. Candidate (a) /ðˤɑC̈tˤ/ does not have a manner of articulation specification in /C̈/; therefore, it is ruled out. Candidate (b) [ðˤɑqtˤ], meanwhile, wins as it satisfies the HAVE MANNER constraint by copying [-cont] the manner of articulation feature of the adjacent segment /tˤ/. [ðˤɑqtˤ] violates the lowest ranked constraint, NOLINK [CONT], but satisfies the higher constraint. Then, /ðˤɑqtˤ/ is inserted for the next derivational step.

The sixth derivational step in Tableau 5-2-f below shows the convergence, in which no additional harmonic improvements to the final input are possible. Consequently, the input in this step is the final optimal output.

(5-2-f) Step 6

/ðˤɑqtˤ/	AGREE [VOICE]	HAVE VOICE	SPREAD [RTR]	AGREE [CONT]	HAVE MANNER	MAX-IO [VOICE]	NOLINK [VOICE]	IDENT-IO [RTR]	MAX-IO [CONT]	NOLINK [CONT]
(6) Convergence /ðˤɑqtˤ/ → [ðˤɑqtˤ]										
☞a. [ðˤɑqtˤ]										

Tableau 5-2 with the steps (5-2-a) - (5-2-f) above and the ranking of the constraints below show the complete set of harmonic improvement steps that /ðˤaʁtˤ/ undergoes to surface as [ðˤɑqtˤ]: AGREE [VOICE] >> HAVE VOICE >> MAX-IO [VOICE] >> NOLINK [VOICE] >> AGREE [CONT] >> HAVE MANNER >> MAX-IO [CONT] >> NOLINK [CONT].

5.5.3 Case (3): Fortition from /ʁ/ to [q] in HA

The examples in (5-11) exhibit alternating behaviour between the voiced uvular fricative /ʁ/ and the voiceless uvular stop [q] in different environments in HA as a result of a fortition process that includes firstly devoicing, then strengthening of the segment through the loss of the [+cont] feature to become a stop segment (Smith, 2007). This is a hybrid example, in which different phonological processes are involved. Considering fortition as a complex process which entails devoicing and manner of articulation change, and given that /ʁ/ is a uvular segment that has a uvularisation effect on neighbouring segments, I consider the input in the analysis of these examples to have already undergone pharyngealisation or uvularisation

and only present the emphasis spread when necessary to avoid repetition of steps presented in the previous examples.

Example 5-11: Fortition /ʁ/ → [q] in HA

	Input	**Output**	**Gloss**
a.	/ʁɑbˁrˁɑ/	[qɑbˁrˁɑ]	'irritant'
b.	/ʁlˁɨɢɑ/	[qlˁɨɢɑ]	'depression'
c.	/lˁʁʉːd/	[lˁqʉːd]	'jowls'

The examples in (5-11) above illustrate the environments in which /ʁ/ surfaces as [q] in HA as a result of a fortition process. These environments include: /ʁ/ in an onset position and /ʁ/ in a consonant cluster or CC sequence.

Onsets are susceptible to the fortition process since this is an inherently strong position (Zoll, 1998; de Lacy, 2001; Smith, 2000, 2002; Gordon, 2004). Thus, the onset entails strong segments (Gordon, 2004). In his research on Latvian child language, Kramer (2017) finds that the *Sonority Sequencing Principle* (SSP) plays a role in militating against having marginal sonorants in the onset consonant cluster. This means that the less sonorous the onset, the more well-formed it is (Kramer, 2017).

The fortition process is gradually applied within the HS-OT analysis through one single harmonic change at a time. In the alternation phenomenon of /ʁ/ to [q], the fortition process applies as follows: first, the segment undergoes devoicing; second, the segment is strengthened by loss of the [+cont] specification to become a stop (Smith, 2007). Therefore, constraints that penalise weak segments in strong positions, such as the onset, are introduced below to account for the /ʁ/ to [q] alternation phenomenon in HA.

According to Kramer (2017), the SSP plays a role in marginal segments. A marginal /ʁ/ in the onset position or in consonant cluster in which /ʁ/, as a voiced uvular fricative [+cont], is more sonorous than /q/, a voiceless uvular stop [-cont]. In other words, a strong segment with the feature specifications

[-voice] and [-cont] is preferred in the onset position. The uvular segments that undergo alternation in HA are /q/ and /ʁ/, with /q/ being stronger than /ʁ/. However, within the HS-OT analysis this alternation must be achieved gradually and harmonically with a single change at a time. Therefore, intermediate derivational steps with an intermediate transitioning segment, /χ/, are necessary for the fortition process from /ʁ/ to [q] in HA. Figure 5-2 shows the harmonic improvements that /ʁ/ undergoes to surface as [q].

Figure 5-2: Harmonic changes in the alternation /ʁ/ → [q]

/ʁ/ → /ɣ/ → /χ/ → /ɢ/ → [q]

However, this alternation from /ʁ/ → [q] occurs gradually with the intermediate variant /χ/ satisfying positional markedness constraints. /χ/ is the intermediate output since /q/, /χ/ and /ʁ/ all have the same place of articulation, i.e. uvular, while /χ/ has the same manner of articulation specification as /ʁ/, which is [+cont], but it differs from /ʁ/ in the feature [voice]. On the other hand, /χ/ has the same voice specification as /q/, which is [-voice], but it differs from /q/ in the feature [cont].

Analyzing these examples of fortition within the HS-OT framework illustrates the ability of HS-OT to account for complex phonological processes such as this one. The following constraints and their definitions are introduced to represent the gradual application of the HA alternation phenomenon between the uvular segments, from /ʁ/ to [q], as a fortition process.

***FRICT [+ VOICE] ONSET**

Assign one violation for every /ʁ/ in the onset position.

IDENT -IO FRICT [VOICE] ONSET

The output fricative segment and its input correspondent must have identical values for the [voice] feature in the onset position.

HAVE [-VOICE] ONSET

Assign one violation mark for every segment that does not have a [-voice] specification in the onset position.

MAX-IO [VOICE] ONSET

Assign one violation mark for every [-voice] segment that has no corresponding [-voice] segment in onset position.

***[CONT] ONSET**

Assign one violation for every /χ/ in onset position.

IDENT -IO [CONT] ONSET

The output segment and its input correspondent must have identical values for the [cont] feature in the onset position.

STRONG [- CONT] ONSET

Onset must have a [-cont] specification.

***ʁ/ COMPLEX**

Assign one violation for every /ʁ/ in a CC sequence.

5.5.3.1 Case (3a): /ʁabˁrˁa/→ [qabˁrˁa]

Tableau 5-3 and the steps (5-3-a) - (5-3-e) show the HS-OT analysis of the word /ʁɑbˁrˁɑ/ → [qɑbˁrˁɑ] 'irritant' in five derivational steps. It should be noted that the emphasis spread in /ʁabra/→ [ʁɑbˁrˁɑ] is the result of a uvularisation process that is triggered by the uvular segment /ʁ/. The uvularisation process occurs before the fortition process satisfying the constraint SPREAD [RTR] and violating the constraint

IDENT-IO [RTR]. However, to avoid repetition of the derivational steps, I consider the input form in the analysis of the cases in (3a) and (3b) to have already undergone uvularisation.

Tableau 5-3 HS-OT analysis of /ʁɑbˁrˁɑ/ → [qɑbˁrˁɑ]

(5-3-a) Step 1

/ʁɑbˁrˁɑ/	*FRICT [+ VOICE] ONSET	IDENT -IO FRICT [VOICE] ONSET
(1) Fortition Devoicing /ʁɑbˁrˁɑ/ → [ɣɑbˁrˁɑ]		
a. /ʁɑbˁrˁɑ/	*!	
☞b. /ɣɑbˁrˁɑ/		*

In the first step, the fortition process begins by devoicing the voiced uvular fricative /ʁ/, since /ʁ/ is penalised in the onset position, respecting the SSP and satisfying the highly ranked constraint, *FRICT [+ VOICE] ONSET. As a result, /ʁ/ loses the voice feature specification [+voice] and changes in to the empty/ unspecified voice feature /ʁ/ → [ɣ]. As a result, the winner in this derivational step is candidate (b) [ɣɑbˁrˁɑ]. Although it violates the faithfulness constraint, IDENT -IO FRICT [VOICE] ONSET, it, nevertheless, satisfies the highest ranked constraint, *FRICT [+VOICE] ONSET. The output of this derivational step is the input in the next one in the HS-OT framework.

(5-3-b) Step 2

/ʁɑbˤrˤɑ/	*Fric [+ Voice] Onset	Have [-Voice] Onset	Ident -IO Fric [Voice] Onset	Max-IO [Voice] Onset
(2) Fortition Devoicing /Ɣɑbˤrˤɑ/→ [χɑbˤrˤɑ]				
a. /Ɣɑbˤrˤɑ/		*!		
☞b. /χɑbˤrˤɑ/				*

In the second step, the fortition process continues with another harmonic improvement forced by the addition of two constraints Have [-Voice] Onset and Max-IO [Voice] Onset. The positional markedness constraint, Have [-Voice] Onset forces the segment to have a specification for the unspecified voice feature /Ɣ/ and it is ranked higher than Ident -IO Fric [Voice] Onset in order to guarantee the continuation of the application of the fortition process in the right order. Therefore, candidate (b) wins [χɑbˤrˤɑ] as its voice feature is specified as [-voice], with /Ɣ/ in the input being replaced with [χ] in the output, thus satisfying Have [-Voice] Onset, but violating the added faithfulness constraint, Max-IO [Voice] Onset. After that, the derivation continues with /χɑbˤrˤɑ/ as the input for the next mapping.

(5-3-c) Step 3

/ʁɑbˤrˤɑ/	*Fricᴛ [+ Voice] Onset	Have [-Voice] Onset	*[Cont] Onset	Ident -IO Fricᴛ [Voice] Onset	Max-IO [Voice] Onset	Ident -IO [Cont] Onset
(3) Fortition [-cont] /χɑbˤrˤɑ/→ [ʗɑbˤrˤɑ]						
a. /χɑbˤrˤɑ/			*!			
☞b. /ʗɑbˤrˤɑ/						*

The third step shows the fortition process continues after the devoicing of a segment is completed. The strengthening continues by converting the segment into a stop with the addition of a markedness constraint for the continuant feature specification, *[Cont] Onset, which militates against the fricative /χ/ in onset position. Therefore, Losing the continuant feature of the intermediate fricative /χ/→ [ʗ] results in the strengthening of the segment from a uvular fricative to a uvular stop. However, this happens gradually and harmonically. As a result, candidate (b) [ʗɑbˤrˤɑ] is the optimal output, since /χ/ becomes unspecified for the continuant feature, [ʗ], satisfying *[Cont] Onset. The winner in this step is inserted as the input for the next derivational step.

(5-3-d) Step 4

/ʗabˁrˁɑ/	*Fricᴛ [+ Voice] Onset	Have [-Voice] Onset	*[Cont] Onset	Strong [- Cont] Onset	Ident -IO Fricᴛ [Voice] Onset	Max-IO [Voice] Onset	Ident -IO [Cont] Onset
(4) Fortition [-cont] /ʗabˁrˁɑ/→ [qabˁrˁɑ]							
a. /ʗabˁrˁɑ/				*!			
☞b. /qabˁrˁɑ/							*

The fortition process continues in the fourth step by imposing a specified continuous feature for the onset [-cont]. Thus, in order for this step to occur, the markedness constraint, Strong [-Cont] Onset, is added. This constraint enforces the strengthening of the segment in the onset position by changing it into a stop segment /ʗ/→ [q]. Therefore, candidate (a) /ʗabˁrˁɑ/ is ruled out, whereas candidate (b) [qabˁrˁɑ], with a specified continuant feature [-cont], wins satisfying Strong [-Cont] Onset. The winner in this step is the input in the next derivational step.

Tableau 5-3-e below shows the fifth step, indicating that the fortition process is complete and no further harmonic improvements to the final output are necessary. Consequently, the convergence occurs when the input and the output forms are identical /qabˁrˁɑ/→ [qabˁrˁɑ].

(5-3-e) Step 5

/ʁɑbˤrˤɑ/	*Frict [+ Voice] Onset	Have [-Voice]	*[Cont] Onset	Strong [- Cont] Onset	Ident -IO Frict [Voice] Onset	Max-IO [Voice] Onset	Ident -IO [Cont] Onset
(5) Convergence /qɑbˤrˤɑ/ → [qɑbˤrˤɑ]							
☞ a. /qɑbˤrˤɑ/							

The previous examples of HA cases have presented the HS-OT analysis of the alternation of /q/→ [ʁ] and /ʁ/→ [q] as a result of assimilation processes or fortition processes. The next two cases show the alternation of /ʁ/→ [q] as a result of fortition processes in which /ʁ/ occurs in onset consonant cluster in case (3b) and as a result of interaction between several phonological processes with more derivational steps satisfying SSP first in case (3c).

5.5.3.2 Case (3b): /ʁlˤiɢah/→ [qlˤiɢah]

Tableau 5-4 and the steps (5-4-a) - (5-4-e) below represent the HS-OT analysis of the word /ʁlˤiɢɑh/→ [qlˤiɢɑh] ‘depression’ in five derivational steps. As I mentioned earlier, I consider the emphasis spread process for the word /ʁligah/ → [ʁlˤiɢɑh] occurs before the fortition process in HA. Instead of repeating the analysis of the emphasis spread here. Accordingly, the input form for case (3b) is the uvularized word /ʁlˤiɢɑh/.

Tableau 5-4 HS-OT analysis of /ʁlˤɨɢɑh/ → [qlˤɨɢɑh]

(5-4-a) Step 1

/ʁlˤɨɢɑh/	*ʁ/ COMPLEX	*FRICT [+ VOICE] ONSET	IDENT -IO FRICT [VOICE] ONSET
(1) Fortition Devoicing /ʁlˤɨɢɑh/ → /ʁlˤɨɢɑh/			
a. /ʁlˤɨɢɑh/	*!	*	
☞b. /ʁlˤɨɢɑh /			*

In the first step, the fortition process starts by devoicing the voiced uvular fricative /ʁ/ since /ʁ/ is not allowed in onset position satisfying *FRICT [+ VOICE] ONSET. In addition, in this example, /ʁ/ also occurs in an onset cluster, which is penalised by the highly ranked constraint, *ʁ/ COMPLEX. Therefore, /ʁ/ loses the voice feature specification and the winner is candidate (b) [ʁlˤɨɢɑh] although it violates the faithfulness constraint, IDENT -IO FRICT [VOICE] ONSET. Since the two constraints, *ʁ/ COMPLEX and *FRICT [+ VOICE] ONSET, lead to the same output, they are not ranked with respect to each other. This is represented by the dotted line between the two constraints. The output of this derivational step is the input to the next one in the HS-OT framework.

(5-4-b) Step 2

/ʁlˤiɢɑh/	*ʁ/ COMPLEX	*FRICT [+ VOICE] ONSET	HAVE [-VOICE] ONSET	IDENT -IO FRICT [VOICE] ONSET	MAX-IO [VOICE] ONSET
(2) Fortition Devoicing /ʁlˤiɢɑh/ → /χlˤiɢɑh/					
a. /ʁlˤiɢɑh/			*!		
☞b. /χlˤiɢɑh/					*

The second derivational step shows that the devoicing process continues with the addition of the positional markedness constraint, HAVE [-VOICE] ONSET, which forces the segment to have a [-voice] specification for the unspecified voice feature in /ʁlˤiɢɑh/. As a result, candidate (b) [χlˤiɢɑh], with /ʁ/ being replaced with [χ], wins satisfying HAVE [-VOICE] ONSET. Thus, violating the added faithfulness constraint MAX-IO [VOICE] ONSET. At this stage of the fortition process, the devoicing is complete. The derivation continues with /χlˤiɢɑh/ as the input for the next step.

The next stage of the fortition process continues by the alternation of the segment /χ/ in /χlˤiɢɑh/ in the manner of articulation from being a fricative segment into a stop segment. However, this change is both harmonic and gradual in the HS-OT analysis as shown in the remainder of the derivational steps of this example.

(5-4-c) Step 3

/χlˤɨɢɑh/	*ʁ/ Complex	*Frict [+ Voice] Onset	Have [-Voice] Onset	*[Cont] Onset	Ident -IO Frict [Voice] Onset	Max-IO [Voice] Onset	Ident -IO [Cont] Onset
(3) Fortition [-cont] /χlˤɨɢɑh/ → [Ɔlˤɨɢɑh]							
a. /χlˤɨɢɑh/				*!			
☞b. /Ɔlˤɨɢɑh/							*

The third step shows the fortition process continues by alternating the manner of articulation of the voiceless fricative /χ/ in /χlˤɨɢɑh/ into the unspecified continuant manner of articulation [Ɔ]. This is asserted by the addition of the markedness constraint, *[Cont] Onset, which militates against the fricative /χ/ in onset position. As a result, candidate (b) [Ɔlˤɨɢɑh] is the optimal output, with the unspecified continuant feature [Ɔ] satisfying *[Cont] Onset. The optimal output in this derivational step violates the low ranked constraint, Ident-IO [Cont] Onset; however, it satisfies a higher constraint in the hierarchy. The derivation continues with /Ɔlˤɨɢɑh/ as the input for the next derivational step.

In order for the fortition process to continue, the fourth derivational step shows the addition of a markedness constraint, Strong [- Cont] Onset. This constraint forces the specification of the unspecified continuant feature in the onset /Ɔlˤɨɢɑh/ and strengthens it to form a stop segment [q]. The winner in this derivational step is candidate (b) [qlˤɨɢɑh] as illustrated in Tableau 5-4-d below.

(5-4-d) Step 4

/ɕlˤɨɢɑh/	*ʁ/ Complex	*Frict [+ Voice] Onset	Have [-Voice] Onset	*[Cont] Onset	Strong [- Cont] Onset	Ident -IO Frict [Voice] Onset	Max-IO [Voice] Onset	Ident -IO [Cont] Onset
(4) Fortition [-cont] /ɕlˤɨɢɑh/ → [qlˤɨɢɑh]								
a. /ɕlˤɨɢɑh/					*!			
☞ b. /qlˤɨɢɑh/								*

(5-4-e) Step 5

/qlˤɨɢɑh/	*ʁ/ Complex	*Frict [+ Voice] Onset	Have [-Voice] Onset	*[Cont] Onset	Strong [- Cont] Onset	Ident -IO Frict [Voice] Onset	Max-IO [Voice] Onset	Ident -IO [Cont] Onset
(5) Convergence /qlˤɨɢɑh/ → [qlˤɨɢɑh]								
☞ a. /qlˤɨɢɑh/								

The winner from the fourth step is inserted as the input for the fifth derivational step. This step shows that the output is identical to the input from /qlˤɨɢɑh/with the voiceless uvular stop /q/ as the least sonorant segment, i.e. the strongest segments there is. In other words, the output requires no further harmonic improvements. As a result, the convergence occurs with the optimal output [qlˤɨɢɑh].

5.5.3.3 Case (3c): /lʁʉːd/→ [ʔˤilˤ.qʉːd]

Tableau 5-5 and the steps (5-5-a) - (5-5-h) illustrate the HS-OT analysis of the word /lʁʉːd/→ [ʔɨlˤ.qʉːd] 'jowls' in HA in eight derivational steps. This example is a complicated one since an additional phonological process is required before the application of the emphasis spread and the fortition processes. Namely, a vowel insertion followed by a glottal stop insertion respecting the Sonority Sequencing Principle (SSP). According to the SSP, marginal sonorants are not acceptable in the onset position within a complex consonant cluster (Gordon, 2004; Kramer, 2017). For this example, the insertion process occurs first satisfying the SSP followed by the emphasis spread process then the alternation of the uvular segment /ʁ/→ [q]. In order to account for the insertion processes: vowel insertion and glottal stop insertion, the following constraints are introduced.

***M/SON**

Assign one violation mark for every sonorant in syllable margins; i.e. onset and coda positions (Smith 2004).

ONSET

Syllables must have an onset (Prince and Smolensky, 1993).

DEP-IO

Every segment of the output has a correspondent in the input (McCarthy and Prince, 1995).

Tableau 5-5 HS-OT analysis of /lʁʉːd/ → [ʔilˁ.qʉːd]

(5-5-a) Step 1

/lʁʉːd/	*M/SON	DEP-IO
(1) V Insertion /lʁʉːd/→ [il.ʁʉːd]		
a. /lʁʉːd/	*!	
☞b. /il.ʁʉːd/		*

In the first step, there is a vowel insertion process due to the SSP, according to which falling sonority is not acceptable in complex consonant clusters in the onset position. Although HA allows onset consonant clusters, falling sonority is penalised by the highly ranked constraint, *M/SON. Therefore, an epenthetic vowel /i/ is inserted and /l/ is resyllabified as the coda of the newly created syllable. The winner is candidate (b) [il.ʁʉːd], although it violates the lower ranked constraint, DEP-IO. The output of this step is then inserted as the input for the next derivational step.

(5-5-b) Step 2

/il.ʁʉːd/	*M/SON	ONSET	DEP-IO
(2) /ʔ/ Insertion /il.ʁʉːd/→ [ʔil.ʁʉːd]			
a. /il.ʁʉːd/		*!	
☞b. /ʔil.ʁʉːd/			*

The insertion continues in the second derivational step, in which a glottal stop /ʔ/ is inserted to fill the empty onset position of the created syllable as a repair strategy to satisfy a higher ranked constraint, ONSET, which militates against any syllable with an empty onset. The constraint, ONSET, is a highly ranked constraint in Arabic and violation of it is considered fatal. As a result, the winner in this derivational step is [ʔil.ʁʉːd], which is then inserted as the input for the next derivational step.

(5-5-c) Step 3

/ʔil.ʁʉːd/	*M/SON	ONSET	SPREAD-IO [RTR]	DEP-IO	IDENT-IO [RTR]
(3) Emphasis spread /ʔil.ʁʉːd/ → [ʔilˤ.ʁʉːd]					
a. /ʔil.ʁʉːd/			*!		
☞b. /ʔɨlˤ.ʁʉːd/					*

The third step includes the emphasis spread process, and shows that these processes are interacting with each other. Vowel insertion, /ʔ/ insertion and resyllabification must be completed before the emphasis spread / uvularisation can spread throughout the entire word, satisfying a higher constraint, SPREAD [RTR]. The optimal output in this derivational step is [ʔɨlˤ.ʁʉːd], which is then inserted as the input for the next derivational step. It is worth noting that also here, the emphasis spread is represented by a single derivational step to avoid repetition resulting in an entirely emphasised word in candidate (b).

(5-5-d) Step 4

/ʔiɬˤ.ʁʉ:d/	*M/SON	ONSET	SPREAD-IO [RTR]	*ʁ/ COMPLEX	*FRICT [+ VOICE] ONSET	DEP-IO	IDENT-IO [RTR]	IDENT -IO FRICT [VOICE] ONSET
(4) Fortition Devoicing /ʔiɬˤ.ʁʉ:d/→ [ʔiɬˤ.Ɣʉ:d]								
a. /ʔiɬˤ.ʁʉ:d/				*!	*			
☞b. /ʔiɬˤ.Ɣʉ:d/								*

The fortition process starts by devoicing the voiced uvular fricative /ʁ/ in the CC sequence as /ʁ/ is in the onset position of the second syllable preceded by the voiced lateral /l/ in the coda of the first syllable. After the completion of the emphasis spread process in the previous step. The optimal output in this step is /ʔiɬˤ.Ɣʉ:d/, in which /ʁ/ loses its specification for the voice feature [+voice] to [Ɣ], satisfying the two highly ranked markedness constraint, *ʁ/ COMPLEX and *FRICT [+ VOICE] ONSET which both assert that /ʁ/ is penalised in the onset and a voiceless segment is preferred in the onset respectively. The winner from this step [ʔiɬˤ.Ɣʉ:d] is inserted as the input for the next derivational step.

(5-5-e) Step 5

/ʔɨlˤ.Ɣʉːd/	*M/SON	ONSET	SPREAD-IO [RTR]	*ʁ/ COMPLEX	*FRICT [+ VOICE] ONSET	HAVE [-VOICE] ONSET	DEP-IO	IDENT-IO [RTR]	IDENT -IO FRICT [VOICE] ONSET	MAX-IO [VOICE] ONSET
(5) Fortition Devoicing /ʔɨlˤ.Ɣʉːd/→ [ʔɨlˤ.χʉːd]										
a. /ʔɨlˤ.Ɣʉːd/						*!				
☞b. /ʔɨlˤ.χʉːd/										*

The fifth step shows that the fortition process is still in progress whereby the voice specification is imposed by the markedness constraint, HAVE [-VOICE] ONSET, which outranks the faithfulness constraint, MAX-IO [VOICE] ONSET. Therefore, the optimal output from this step is [ʔɨlˤ.χʉːd] with the unspecified [voice] feature /Ɣ/→ the specified voice feature [-voice] in [χ] . The winner of this step is then inserted as the input for the next derivational step.

The sixth step shows the fortition process for the segment under alternation, which is strengthened by changing the segment from the fricative /χ/ into a stop segment. However, this change must apply harmonically and gradually. As a fricative segment. /χ/ has the specification of the continuant feature [+cont], which differs from the adjacent lateral /l/ in the CC sequence with the feature [-cont]. Therefore, /χ/ surfaces in this step with the unspecified continuant feature [∅] in [ʔɨlˤ.∅ʉːd] in order to for [∅] to copy the [-cont] feature of /l/ in the next derivational step. The winner in candidate (b) thereby satisfies the

markedness constraint, *[CONT] ONSET although it violates the low ranked constraint, IDENT -IO [CONT] ONSET. Therefore, /ʔɨlˤ.ɕʉːd/ is then inserted as the input for the next derivational step.

(5-5-f) Step 6

/ʔɨlˤ.χʉːd/	*M/SON	ONSET	SPREAD-IO [RTR]	*ʁ/ COMPLEX	*FRICT [+ VOICE] ONSET	HAVE [-VOICE] ONSET	*[CONT] ONSET	STRONG [- CONT] ONSET	DEP-IO	IDENT-IO [RTR]	IDENT -IO FRICT [VOICE] ONSET	MAX-IO [VOICE] ONSET	IDENT -IO [CONT] ONSET
(6) Fortition [-cont] /ʔɨlˤ.χʉːd/→ [ʔɨlˤ.ɕʉːd]													
a. /ʔɨlˤ.χʉːd/							*!						
☞b. /ʔɨlˤ.ɕʉːd/													*

(5-5-g) Step 7

/ʔɨlˤ.ɕʉːd/	*M/SON	ONSET	SPREAD-IO [RTR]	*ʁ/ COMPLEX	*FRICT [+ VOICE] ONSET	HAVE [-VOICE] ONSET	*[CONT] ONSET	STRONG [- CONT] ONSET	DEP-IO	IDENT-IO [RTR]	IDENT -IO FRICT [VOICE] ONSET	MAX-IO [VOICE] ONSET	IDENT -IO [CONT] ONSET
(7) Fortition [-cont] /ʔɨlˤ.ɕʉːd/→ [ʔɨlˤ.qʉːd]													
a. /ʔɨlˤ.ɕʉːd/								*!					
☞b. /ʔɨlˤ.qʉːd/													*

The seventh step shows the addition of the markedness constraint, STRONG [-CONT] ONSET, which imposes specification of the unspecified continuant feature /ℂ/. As a result, /ℂ/ copies the [-cont] feature of the adjacent lateral /l/ in the CC sequence resulting in the voiceless uvular stop [q]. Consequently, the optimal output in this derivational step is [ʔɨlˤ.qʉːd], which is then inserted as the input for the next derivational step.

(5-5-h) Step 8

/ʔɨlˤ.qʉːd/	*M/SON	ONSET	SPREAD-IO [RTR]	*ʁ/ COMPLEX	*FRICT [+ VOICE] ONSET	HAVE [-VOICE] ONSET	*[CONT] ONSET	STRONG [- CONT] ONSET	DEP-IO	IDENT-IO [RTR]	IDENT -IO FRICT [VOICE] ONSET	MAX-IO [VOICE] ONSET	IDENT -IO [CONT] ONSET
(8) Convergence /ʔɨlˤ.qʉːd/→ [ʔɨlˤ.qʉːd]													
☞ a. /ʔɨlˤ.qʉːd/													

Tableau 5-5-h shows the eighth and final step in this derivation. The convergence to the final output [ʔɨlˤ.qʉːd] occurs when no further harmonic improvements are necessary or possible where the input and the output show no change.

From the HA examples presented and analyzed in this chapter, it can be established that the fortition process is a complicated phonological process which involves the gradual devoicing and losing of the continuant feature of the alternating uvular segments /q/ and /ʁ/. As discussed in this chapter, the alternation from /q/ to [ʁ] in HA occurs due to an assimilation process in a very limited number of instances in the data collected, whereas the majority of alternations in the HA data are instances of /ʁ/ to [q] alternation.

The alternation from /ʁ/ to [q] in HA is prominent. As a result, the ranking of the phonological processes discussed in this study is as follows:

Resyllabification >> Fortition: Devoicing >> -Cont >> Voice assimilation >> Emphasis spread >> Manner of articulation assimilation.

5.6 Conclusion

This chapter has investigated the alternation phenomenon involving the uvular segments /ʁ/ and /q/ in HA. The aim of the chapter has been to establish an alternation pattern for uvular segments that contradicts the previous suggestion in the literature of a free variation with no phonological explanation. A pattern has been achieved, presented, discussed and analysed within the framework of HS-OT. The data show a clear pattern of the uvular alternation in HA where /q/ is preserved in some environment. Whereas the majority of the cases shows /ʁ/ to [q] alternation which indicates a segmental shift is in progress in HA. Nevertheless, an interesting environment for the alternation of /q/ to [ʁ] is the same environment for the preserving of [ʁ] from alternating in HA. This environment being the adjacency of uvular segments /q/ and /ʁ/ to the trill /r/. When /q/ occurs word-medially, in the coda of the first syllable and /r/ is in the onset of the second syllable, in this case, /q/ will alternate into [ʁ]. Whereas /ʁ/ will be preserved if it occurs in a word-medially position, in the coda of the first syllable and /r/ is in the onset of the second syllable.

The chapter has also shed some light on the status of the alternation between the velar and uvular segments, /g/ and /ɢ/, in HA. While /ɢ/ is an allophone of /q/ in HA as a result of a voice assimilation process, it is also an allophone of /g/ as a result of a pharyngealisation / emphasis spread process triggered by an adjacent back / pharyngealised vowel. In addition, /ɢ/ is also phonemic in HA with lexical items presented in this study that appears in the dialect invariably with /q/. A brief reference of literature to

similar alternation phenomenon in the Gulf dialects of Arabic and other languages have been presented in the chapter.

A phonological analysis within the HS-OT perspective of the interacting processes is provided. To the best of my knowledge, this research provides the first HS-OT analysis for the phenomenon of alternation among the uvular segments, /q/ and /ʁ/, in HA. Analysing this alternation phenomenon in HA has contributed to the ability of HS-OT in terms of accounting for such a complex phonological phenomenon which involves more than one phonological process. This chapter has shown the interaction between different phonological processes, such as emphasis spread, voice assimilation and manner of articulation assimilation. In addition, it has illustrated the effect of the SSP on the alternation from /ʁ/ to [q] with the insertion of the epenthetic vowel /i/ and the glottal stop /ʔ/ as a repair strategy in HA, all of which have been analysed within the HS-OT framework.

To the best of my knowledge, there is no research that has systematically studied this uvular segment alternations phenomenon in HA. This chapter is significant because it fills the gap in the literature related to this alternation phenomenon in this understudied dialect. A large amount of the data is extracted from several interviews that I have conducted with 50 participants, who are native speakers of the dialect. In addition, the data is complemented by extra forms from social media, namely snapchat application, from which I added some elicited lexical forms to my list of words by following users of the application in their daily routines for a short period of time. The users I followed are all native speakers of HA dialect and they are made aware of the research goals and their approvals have been obtained beforehand. The latter method of collecting data adds to the significance of the research.

The following chapter provides a summary of the study and the most important findings are discussed. Recommendations and ideas for future research are presented and the advantages and disadvantages of

adopting the HS-OT as the framework for analysis in this study is discussed. The contribution of this original study is stipulated.

6 Chapter Six: Summary and Conclusion

6.1 Introduction

This chapter summarizes the study of aspects of HA phonology while once again evaluating the findings within the analytical framework employed, i.e. HS-OT. In this study, I have started by introducing a brief historical background of the area and the dialect, focusing on the consonants of HA, the phenomena under investigation, a description of the dialect sound system, and a brief account of the syllable structure that incorporates phonetic and phonological perspectives. The focus of the study is three phonological processes: pharyngealisation/ uvularisation and the alternation of uvular segments in HA. This chapter provides an insight into the advantages, as well as the disadvantages, of employing HS-OT as the framework of analysis.

6.2 Summary of the study and results

Chapter 1 has presented an overview of the study, including the area in which the HA dialect is spoken, i.e. Alahsa, locally known as Hassa, along with a historical background and an introduction to the phenomena under investigation: pharyngealisation/ uvularisation and the uvular alternation. It has also introduced the participants in the study and the methods by which the data have been collected and recorded.

In chapter 2 I have provided a description of the HA dialect, including the segmental inventory, i.e. consonants and vowels. The syllable structure and stress assignment in HA are also presented and discussed with mono-syllabic, disyllabic, trisyllabic and poly-syllabic words. Initial consonant clusters are allowed in HA as a result of syncope and metathesis processes and it is evident from the provided examples from the dialect. The assignment of the stress in HA always falls in the heaviest syllable. The

right-most superheavy syllable in a word always gets stressed. Stress in HA is weight-sensitive and position-sensitive. As a result, the stress could be assigned to an ultimate, penultimate or antepenultimate syllable depending on the weight of the syllable.

Specific segments under investigation in this study, i.e. /q/, /ɢ/, and /g/ received more attention in this chapter. It is hypothesised that the velar segment /g/ not the uvular /q/ is the UR of the local lexicalised items in HA examples with the segment [g]. However, the provided examples from the dialect prove that the segment /q/ is still alive in HA, while the affrication of /g/ to [ʤ] proves that the change from /q/ to [g] happened so long ago that /g/ is considered the UR in some of the lexicalised items in which /q/ is no longer the UR. Therefore, the addition of the segment /g/ is exhibited in the consonantal inventory of HA.

Other studies in the literature argue for the /q/ to [g] substitution. However, there is no systematic study that shows the emphasis effect of the segment /q/ is kept by the segment /g/ through this substitution. In general, the segment /g/ is associated with front vowel /a/ where it does not generate an emphasis effect. Whereas when it occurs in a pharyngealised environment, i.e. in the vicinity of the pharyngealised segments /tˁ, ðˁ, sˁ/ and/ or the back vowels /ɑ, ɨ, ʉ/, then /g/ surfaces as the uvular [ɢ]. Consequently, the segment /g/ is phonemic in HA while the segment /ɢ/ is allophonic.

Chapter 3 has provided a theoretical background, including Optimality Theory and other versions of OT that have stemmed from it, such as HS-OT. A justification for adopting the HS-OT framework in this thesis for such phenomena in HA, i.e. pharyngealisation, uvularisation and alternation among the uvular segments, has been provided. HS-OT has been adopted as the framework of analysis in a dialect related to HA, i.e. KA, in which it has proven feasible. However, in this study, in addition to analysis of the pharyngealised segments, /tˁ, sˁ, ðˁ/, HS-OT is adopted for analysis of pharyngealisation / uvularisation triggered by the uvular segments /q, ɢ, χ, ʁ/ in HA. It has been shown that emphasis spread from the uvulars and the alternation of the uvular segments are gradual processes in HA. More interestingly, the

uvular segments appear to have long-distance emphasis spread with a heavier degree of emphasis spreading progressively. Whereas the pharyngealised segments appear to have long-distance emphasis spread with a heavier degree of emphasis spreading regressively. A feature geometry FG model has been presented as a phonological illustration of a triggered feature spread. Although there is no total consensus in the literature, the feature [RTR] has been adopted in this study to represent the emphasis triggered by the pharyngealised /tˤ, sˤ, ðˤ/, uvular /q, ɢ, χ, ʁ/, but not the velar /g/ segments.

In addition, as discussed in chapter 5 with further examples, due to the complex nature of the alternation phenomenon among the uvular segments in HA and the various phonological processes involved, HS-OT is the correct version of OT for this kind of phenomenon. This is because it shows the derivation from the input to output gradually and harmonically with one change at a time with a fixed constraint ranking. However, Classical / Parallel OT chooses which of the candidates for output is the best from a single derivational step. While the alternating segments in HA, /q/ and /ʁ/, share the same place of articulation, i.e. uvular, they differ in their specifications for the features [voice] and [cont]. The analysis within the HS-OT framework has proven capable of capturing such a complicated phonological phenomenon gracefully.

The emphatic / pharyngealised segments /tˤ, sˤ, ðˤ/, uvular segments /q, ɢ, χ, ʁ/, and the velar segment /g/ in HA have been investigated in detail in chapter 4. There is also discussion of the classification of guttural sounds in HA, and the effects of the segments investigated on adjacent sounds across different domains. In addition, the phonological status of the velar segment /g/ and the uvular sounds in HA, i.e. /q, ɢ, χ, ʁ/, have been investigated. This chapter has aimed at establishing an account of the emphasis spread effect triggered by the investigated segments in HA, especially the uvular segments.

A brief phonetic analysis using PRAAT has been conducted to unveil the effect and correlates of

uvular sounds and uvularisation in HA. The chapter provides a comparison of pharyngealisation and uvularisation in regard to the degree of lowering of the F2 value in the adjacent sounds and in the domain of emphasis spread in HA.

A phonological analysis within the HS-OT perspective of pharyngealisation and uvularisation is provided. Utilising the HS-OT framework in formalising the processes has provided a gradual explanation and a better understanding of more complex examples that would have been difficult to explain using other frameworks. The gradual harmonic improvements of HS-OT successfully predict intermediate derivational steps and the order of the application of different phonological processes.

Chapter 5 has presented answers in relation to the phenomenon of alternation among the uvular segments in HA, whereby a clear pattern is obtained. This analysis of the alternation between uvular /q/ and /ʁ/ in HA challenges the assumption reported in the literature that there is free variation among these alternating segments. Instead, a pattern for this alternation has been found and presented in this chapter. This alternation phenomenon is complicated in the sense that it involves more than one phonological process; these processes are voice assimilation, manner of articulation assimilation and, in some of the examples, vowel insertion and resyllabification satisfying the SSP.

The pattern revealed in this chapter is as follows: no change to either the uvular stop /q/ or the uvular fricative /ʁ/ in specific environments. This shows that both the voiceless uvular stop /q/ and the voiced uvular fricative /ʁ/ are still active segments in the dialect. However, a clear pattern is obtained whereby /ʁ/ alternates to [q] in most of the cases examined in this study. /q/ is maintained in the vicinity of the back vowels /ɑ/ and /ʉ/; it is also preserved adjacent to a voiceless stop / obstruent segment and in a pharyngealised environment. While /q/ alternates to the voiced uvular stop [ɢ] when adjacent to a voiced segment in a uvularisation environment, it surfaces as [g] when adjacent to a voiced segment in the vicinity of the high front vowels /i/ and [æ] or the mid vowel /a/; in such instances it additionally exhibits fronting in

lexicalised items in the dialect. /q/ surfaces as [ʁ] in one environment, such as in /taq.riːban/ → [taʁ.riːban] ‘almost’, in which /q/ is in the coda position of an unstressed syllable followed by /r/ in the onset of a stressed syllable. On the other hand, the voiced uvular segment /ʁ/ alternates with /q/ in most of the attested examples in the HA data. /ʁ/ surfaces as [ʁ] in environments in which it occurs in the coda position of an unstressed syllable followed by /r/ in the onset of a stressed syllable, as in /mˤɑʁ.rib/ → [mˤɑʁ.rib] ‘sunset’. However, /ʁ/ surfaces as [q] elsewhere, satisfying different highly ranked constraints in different examples. Whether it is in the onset position, in a consonant cluster in onset position, in a CC sequence word-medially, or in a sequence of three voiced segments, /ʁ/ will always surface as [q] in HA. As for the resyllabification process including /ʁ/ which applies to prevent the occurrence of /ʁ/ in an onset consonant cluster, this does not change the fact that /ʁ/ will still end up in a CC sequence as the onset of the second syllable preceded by the coda of the first syllable. Resyllabification may fix the sonority issue, as in an example such as /lʁʉːd/ → [ʔil.ʁʉd] ‘jowls’, but /ʁ/ still surfaces as [q] in a CC sequence.

This chapter also shows the interaction between the pharyngealisation spread process and the alternation or the preservation of the voiceless uvular stop /q/. Whenever there are pharyngealised vowels /ɑ/ or /ʉ/, or other pharyngealised segments in the vicinity, then /q/ is preserved, and consequently /ʁ/ mostly surfaces as [q].

It is still somewhat confusing though, especially for people who are not familiar with the HA dialect, that /q/ remains as [q] or becomes [ɢ], whereas /ʁ/ becomes [q] for the most part, except in one single environment. This tells us that we are witnessing a sound change in progress.

6.3 The contributions of this study

Although the pharyngealisation process is widely studied in the literature, this study, to the best of my knowledge, provides the first contribution to investigate the pharyngealisation phenomenon in HA from

a HS-OT framework. In addition to the well-reported effect of the coronal emphatic segments, /tˤ, ðˤ, sˤ/, this study is also the first one to investigates the emphasis effect triggered by the uvular segments in HA, /q, χ, ʁ, ɢ/, i.e. uvularisation from a HS-OT perspective. This study provides the first acoustic comparison between the emphasis effect triggered by the pharyngealised and the uvular segments in HA which interestingly shows a heavy lowering of the F_2 in the vicinity of the uvular segments in HA using Praat. Most importantly, it is the first work to investigate the uvular segment /ʁ/ and /q/ alternation systematically in HA from a HS-OT perspective. Although this alternation phenomenon is mentioned in the literature, it has not been perused. This motivates additional phonological investigations of related dialects as well as languages that exhibit similar phenomena. Also report on the direction of emphasis spread difference between pharyngealised segments vs. uvular segments which is one of the significant findings. The pharyngealised segments tends to have a heavier emphasis spread regressively whereas the uvular segments tend to have a heavier emphasis spread progressively which is evident in the F_2 measurements in the vicinity of the pharyngealised and uvular segments respectively.

6.4 Future work

The phenomenon of fronting of the voiceless uvular stop /q/ to the voiced velar stop [ɡ] is noted in this research. However, it is left for future research due to time limitations. On the other hand, the velar /ɡ/ alternates with the palato-alveolar /ʤ/ in HA, whereby /ɡ/ undergoes an affrication process. This is left for future research as well. It is worth examining the same phenomenon of uvular alternation in dialects related to HA, such as Kuwaiti Arabic and Qatari Arabic, since the phenomenon of /ʁ, q/ alternation has been reported but, to the best of my knowledge, has not been studied. It would be great if I could conduct a comparative study of HA, Kuwaiti Arabic and Qatari Arabic to find out if these dialects have similar patterns of uvular alternation. After that, a comparative study with another language that exhibits a similar

phenomenon, such as Kazakh, in which uvulars associate with ‘strong’ (i.e. back) vowels would be feasible. Revisiting the same data using another version of OT as the analysis framework, such as Stochastic OT, would give a totally different perspective on understanding the participants’ performance.

6.5 Advantages and disadvantages of HS-OT

As mentioned in section 6.3 above, HS-OT formed the perfect analytical framework to analyze a complicated phonological phenomenon such as the alternating uvular segments in HA. It provides a better explanation of the gradual changes with the intermediate derivational steps. The strict constraint ranking kept everything going smoothly, harmonically and gradually with one harmonical change at a time showing the interaction between phonological processes.

However, utilizing the HS-OT framework entails having so many derivational steps for every analysed example. The mechanism of applying one harmonic change at a time causes a repetition in some processes such as the spread of [RTR] feature until the whole targeted domain is covered. Some ad hoc constraints are postulated to ensure the application of other phonological processes in separate derivational steps. This results in a large number of cumulating constraints in the end of an analysis of a complicated example.

Appendices

Appendix 1: List of Constraints

Constraints	Definition
FTBIN	Feet must be binary under syllabic or moraic analysis
ONSET	Syllables must have an onset
MAX	prohibits deletion
DEP	prohibits epenthesis
CONTIG	Input-Output constituents form a contiguous string.
IDENT(F)	is a family of constraints, one for each distinctive feature F, that prohibit changing feature values
*COMPLEX-ONSET	assign a violation for consonant clusters syllable initial position
*CODA	assign a violation for consonants in syllable final position
*DORSAL	assign a violation for having dorsal structure
ALIGN(FT R, PRWD R)	the right edge of every foot must align with the right edge of the prosodic word
SPREAD [RTR] adj (X)	The [RTR] feature of a trigger [tˁ, ðˁ, sˁ] (x) is associated with targeted adjacent segments (y) in the stem enforcing [RTR] spread leftward, rightward and bidirectional gradually segment by segment (Padgett, 1997).
SPREAD [RTR]-D	Every feature [RTR] is linked to every segment within a specific domain (Padgett, 1997).
IDENT-IO [RTR]	The output segment and its input correspondent must have identical values for the feature [RTR] (McCarthy and Prince, 1995).
SPREAD [RTR]	Every feature [RTR] is linked to every segment within a word (Padgett, 1997).
SPREAD [RTR] Coda-L	The emphatics located in coda position must firstly spread its emphasis regressively covering the first part of the word and then spread its ES progressively to the second part of the word (Aldaihani, 2014).
SPREAD [RTR] Onset-R.	The emphatics located in onset position must firstly spread its emphasis progressively covering the second part of the word and then spread its ES regressively to the first part of the word (Aldaihani, 2014).
L/R- ANCHOR (stem, σ)	The segment that begins (suffix) or ends (prefix) the input of the morphological constituent must stand in correspondence with the segment that begins or ends (stem)

	the output of the prosodic constituent (McCarthy & Prince 1995).
IDENT-IO- σ	The number of the syllables in the input must be preserved in its output correspondent.
SPREAD [RTR] W2Onset # W1Coda	An emphatic segment in the onset potion of the second word must regressively spread the feature value [RTR] to an adjacent plain counterpart segment in the coda position of the first word in the phrase.
AGREE [VOICE] W2Onset # W1Coda	The uvular coda of the first word must agree to the counterpart onset of the following word in feature [voice] at post-lexical level.
HAVE VOICE	Assign one violation mark for every segment that has no voice specification.
NOLINK [VOICE]	Assign one violation mark for linking the unspecified [Voice] coda /ɣ/ with the onset in the voice feature.
MAX-IO [VOICE]	Let nasal tier= p1 p2 p3…pn and output Voice tier= p1 p2 p3…pn. Assign one violation mark for every px that has no corresponding py (McCarthy, 2008b).
PRESERVE /q/	Assign one violation mark when an input /q/ is not preserved in the output.
AGREE [VOICE]	The uvular segment in a CC sequence must agree with the adjacent segment for the feature [voice] at the lexical level.
AGREE [CONT]	The uvular segment in a CC sequence must agree with the adjacent segment for the feature [cont] at the lexical level.
HAVE MANNER	Assign one violation mark for every segment that has no manner of articulation specification.
MAX-IO [CONT]	Assign one violation mark for every p_x that has no corresponding p_y in the [cont] feature.
NOLINK [CONT]	Assign one violation mark for linking the unspecified [cont] coda /ʗ/ with the onset or coda cluster in the [cont] feature.
*FRICT [+ VOICE] ONSET	Assign one violation for every /ʁ/ in the onset position.
IDENT -IO FRICT [VOICE] ONSET	The output fricative segment and its input correspondent must have identical values for the [voice] feature in the onset position.
HAVE [-VOICE] ONSET	Assign one violation mark for every segment that does not have a [-voice] specification in the onset position.
MAX-IO [VOICE] ONSET	Assign one violation mark for every [-voice] segment that has no corresponding [-voice] segment in onset position.

*[CONT] ONSET	Assign one violation for every intermediate /χ/ in onset position.
IDENT -IO [CONT] ONSET	The output segment and its input correspondent must have identical values for the [cont] feature in the onset position.
STRONG [- CONT] ONSET	Onset must have a [-cont] specification.
*ʁ/ COMPLEX	Assign one violation for every /ʁ/ in a CC sequence.
*M/SON	Assign one violation mark for every sonorant in syllable margins; i.e. onset and coda positions (Smith 2004).
DEP-IO	Every segment of the output has a correspondent in the input (McCarthy and Prince, 1995).

Appendix 2: The overall ranking of constraints

There are several phonological processes discussed in this study which interact with each other apply in certain order in HA. These processes are: Resyllabification, Insertion, Voice assimilation, Manner of articulation assimilation, Emphasis spread. The fortition process involves two more processes which incurs losing specifications of the features [voice] and [cont] satisfying other highly ranked constraints in the dialect. Each process involves a certain set of constraints. The following constraints show the interaction between pharyngealisation and other processes in HA as discussed in this study. The order of these processes in HA reflects in the ranking of the constraints:

*M/SON >> ONSET >>

*ʁ/ COMPLEX, *FRICT [+ VOICE] ONSET >> HAVE [-VOICE] ONSET >> *[CONT] ONSET >> STRONG [-CONT] ONSET >> DEP-IO >> IDENT -IO FRICT [VOICE] ONSET >> MAX-IO [VOICE] ONSET >> IDENT -IO [CONT] ONSET>>

AGREE [VOICE] >> HAVE VOICE >>

SPREAD [RTR] adj (X), SPREAD [RTR]-D, SPREAD [RTR], SPREAD [RTR] Coda-L, SPREAD [RTR] Onset-R, SPREAD [RTR] W2Onset # W1Coda, SPREAD-IO [RTR] >>

AGREE [CONT] >> HAVE MANNER >>

L- ANCHOR (stem, σ), R- ANCHOR (stem, σ) >> MAX-IO [VOICE], NOLINK [VOICE] >> IDENT-IO- σ, IDENT-IO [RTR] >> NOLINK [CONT], MAX-IO [CONT]

However, as presented in chapter 5, the alternation processes of the uvular segments /q/ and /ʁ/ could be the result of assimilation processes, i.e. a voice assimilation process or a manner of articulation process on one hand. On the other hand, the alternation from /ʁ/ → [q] is more prominent in HA due to a

fortition process which applies after the assimilation processes have occurred. The fortition process applies gradually according to the HS'S GEN satisfying higher ranked constraints in the dialect. First, there is the devoicing, i.e. where the segment /ʁ/ loses the specification of the feature [+voice]. Then, there is the loss of the specification of the feature [+cont] which consequently leads to the optimal surface form [q]. As part of the fortition process, other processes such as insertion and resyllabification apply respecting SSP. As a result, the ranking of the processes in HA is as follows:

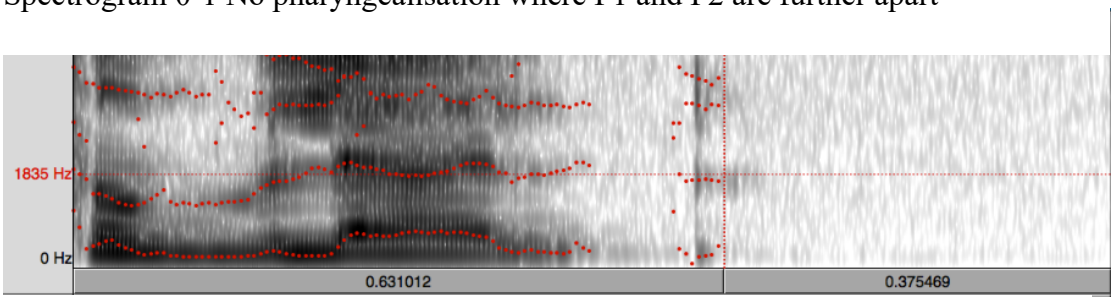
Resyllabification >> Fortition: Devoicing >> -Cont >> Voice assimilation >> Emphasis spread >> Manner of articulation assimilation.

Appendix 3: Spectrogram examples from the PRAAT analysis

The occurrence of the pharyngealisation and uvularisation in HA decided by acoustically measuring the emphasis effect, i.e. the F1 and F2 of all the instances containing the segments under investigation. There are two main pharyngealisation / uvularisation environments as reported in the previous studies: a. in the vicinity of the pharyngealised segments in HA /sˤ, tˤ, ðˤ/; b. in the vicinity of the uvular segments in HA /χ, ʁ, q, ɢ/. Following Shar and Ingram (2010) and Newman and Verhoeven (2002), in order to decide whether the uvular segments have an emphasis effect in HA or not, the emphasis is measured by looking at the spread distance between F1 and F2 for each word in the two main emphasis environments mentioned above separately.

Emphasis in Arabic is generally characterised by the narrow distance '*spread'* between the F1 and F2 of the adjacent vowels. Notably, when comparing minimal pairs of plain /t, ð, s/ with their pharyngealised counterparts /tˤ, ðˤ, sˤ/, the examples with the pharyngealised segments demonstrate a raise in F1 and a drop in F2, which brings the two formants closer together in the adjacent vowels and consonants (Shar and Ingram, 2010; Newman and Verhoeven, 2002). This is shown in the spectrographs 1 to 4 below of some examples taken from the collected data in HA. The acoustic analysis of pharyngealisation and uvularisation using PRAAT shows the difference between plain environments and the emphasis spread triggered by adjacency to pharyngealised segments /tˤ, ðˤ, sˤ/ as well as adjacency to uvular segments /χ, ʁ, q, ɢ/ in HA.

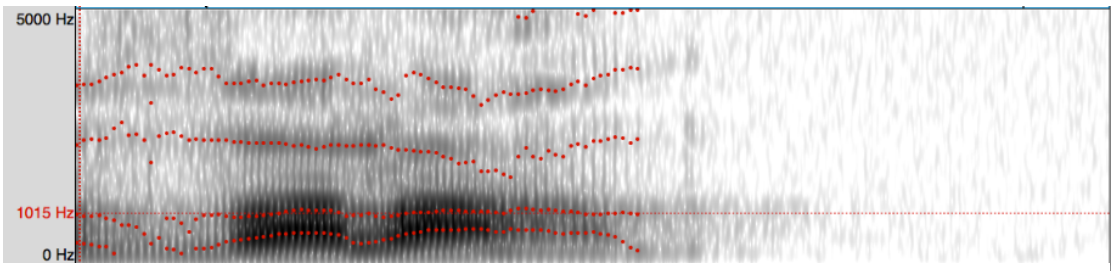
Spectrogram 0-1 No pharyngealisation where F1 and F2 are further apart



Spectrogram 1 Bidirectional spreading of the plain segment /ð/, female speaker. A horizontal marker indicates a midpoint F2 frequency showing an increasing progressive uvularisation effect than the regressive one in HA.

Spectrogram 1 shows no pharyngealisation effect since this example contains the plain segment /ð/. The tow formants, i.e. F1 and F2 are further apart from each other throughout the entire word. The opposite can be seen in spectrograph 2 below which shows pharyngealisation environment manifested in the pharyngealised /ðˤ/.

Spectrogram 0-2 Pharyngealisation where F1 and F2 are closer to each other



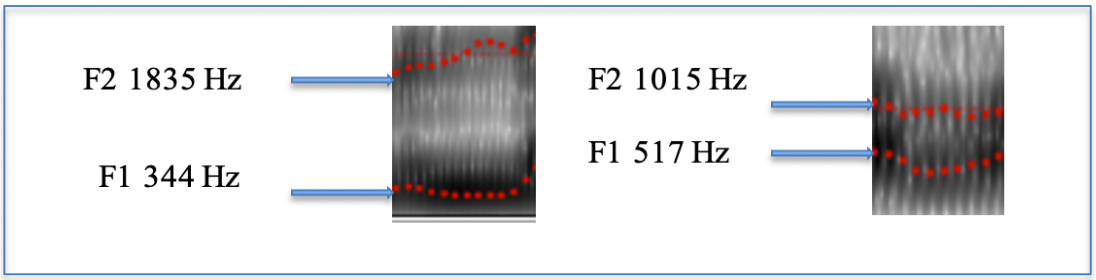
Spectrogram 2 Bidirectional spreading of the pharyngealised segment /ðˤ/, female speaker. A horizontal marker indicates a midpoint F2 frequency showing an increasing progressive uvularisation effect than the regressive one in HA.

Spectrogram 2 shows a progressive pharyngealisation effect triggered by the pharyngealised fricative /ðˤ/. The pharyngealisation effect is manifested in F1 and F2 appearing close to each other throughout the entire word.

Spectrogram 3 below shows a closer picture of the spread difference between the two formants in both the plain vs. the pharyngealisation environment from spectrograph 1 and 2 above with the values of F_1 and F_2 in both spectrographs. The pharyngealisation degree is measured with PRAAT software by placing the curser somewhere in the middle of the transitional vowel. Then, the values of F1 and F2 are

taken from the list of formants. In the plain environment with /ð/, the spread distance between the two formants is wide. F_1 is low at 344 Hz. and F_2 is high at 1835 Hz. On the other hand, in the pharyngealised environment with /ðˤ/, the spread distance between the two formants is narrow. F_1 is slightly higher at 517 Hz. and F_2 is lower at 1015 Hz. The difference in the spread distance between F_1 and F_2 in the plain /ð/ vs. the pharyngealised /ðˤ/ can be seen visually in Spectrograph 3 below.

Spectrogram 0-3 A closer look to F_1 and F_2 in plain vs. pharyngealised environments in HA

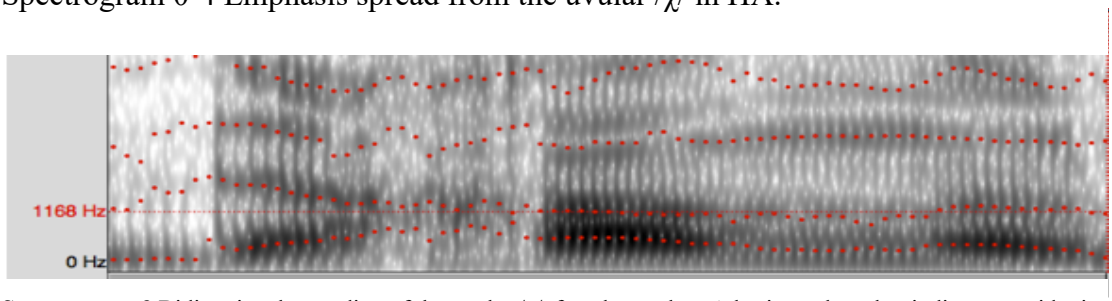


Spectrogram 1 A closer look to F_1 and F_2 in plain vs. pharyngealised environments in HA

Spectrogram 3 shows that the difference in the spread distance between the two formants in the vicinity of the plain /ð/ vs. the pharyngealised /ðˤ/ is substantial. In the vicinity of the plain /ð/, the spread distance between F_1 and F_2 is 1491 Hz, whereas in vicinity of the pharyngealised /ðˤ/ the spread distance between F_1 and F_2 is 498 Hz.

On the other hand, the emphasis spread triggered by the uvular /χ/ as shown in spectrogram 4 below depicts the occurrence of an emphasis effect triggered by the uvular /χ/. It is clear in the spectrograph that the uvular /χ/ as well as /ʁ/ and /ɢ/ have an effect similar to the pharyngealisation effect of the pharyngealised consonants /sˤ, tˤ, ðˤ/ in HA.

Spectrogram 0-4 Emphasis spread from the uvular /χ/ in HA.



Spectrogram 3 Bidirectional spreading of the uvular /χ/, female speaker. A horizontal marker indicates a midpoint F2 frequency showing an increasing progressive uvularisation effect than the regressive one in HA.

A difference in the spread distance between the two formants, i.e. F_1 and F_2 is noticed in the vicinity of pharyngealised segments vs. the uvular segments indicating a difference in the degree of emphasis in HA. The degree of pharyngealisation or uvularisation refers to how close the two formants are to each other during the articulation of an emphatic sound be it a pharyngealised or a uvular segment. The closer the formants are, the heavier the emphasis becomes and vice versa. These findings contradict the previous studies which report that the emphasis effect that is triggered by the pharyngealised segments is the heaviest. However, this is not the case in HA. The uvular segments /χ, ʁ, q, ɢ/ seem to have a heavier emphasis effect in HA as presented in Table 3-3 page 40.

Appendix 4: HA compiled data

	Input	**Output**	**Gloss**
Examples of /g/ in HA			
	/gaʃ/	[gaʃ]	‘Personal belongings’
	/haga/	[haga]	‘thought to’
	/ʔagʃar/	[ʔagʃar]	‘aggressive’
Examples /g/ and /ɢ/ in HA			
	/gargar/	[gargar]	‘chatter’
	/sˤarɢaʕ/	[sˤarˤɢaʕ]	‘reckless’
	/ʃaŋgaħ/	[ʃaŋgaħ]	‘flip’
Examples /q/ in HA			
	/qiːfa/	[qɨːfa]	‘ugly’
	/qanʧa/	[qɑnʧa]	‘serving dish’
	/quħ/	[qʉħ]	‘original’
	/qalb/	[qɑlb]	‘pendant’
	/qaθrah/	[qɑθrɑh]	‘a mess’
	/qamħ/	[qɑmħ]	‘wheat’
	/qitˤaːr/	[qɨtˤɑːrˤ]	‘a train’
	/muqaːbalah/	[muqɑːbalah]	‘an interview’
	/qanaːh/	[qɑnˤɑːh]	‘a chanel’
	/qaːbil/	[qɑːbil]	‘accept’
	/qurʕah/	[qʉrˤʕɑh]	‘a toss’
	/fustuq/	[fustuq]	‘pistachio’
	/qarjah/	[qɑrˤjah]	‘a village’
	/ʔaqallid/	[ʔaqɑllid]	‘imitate’
	/mantˤiqah/	[mɑnˤtˤɨqɑh]	‘area’
	/tˤariːqah/	[tˤɑrˤɨːqɑh]	‘a way’
Examples phonemic status of /q/ and /g/ in HA			
	/rawɑːq/	[rawɑːq]	‘gallery’
	/rawaːg/	[rawaːg]	‘chill’
	/qir/	[qɨr]	‘confess’

	/qɑʃ/	[qɑʃ]	‘straw’
	/gaʃ/	[gaʃ]	‘luggage’
	/qɑlb/	[qɑlb]	‘pendant’
	/qɑsˤɨrˤ/	[qɑsˤɨrˤ]	‘shorten’
Examples allophonic status of [ɢ] in HA			
	/ʔɑqbˤɑʕ/	[ʔɑɢbˤɑʕ]	‘escape’
	/bʉqʕah/	[bʉɢʕah]	‘a stain’
	/gɨr/	[gɨrˤi]	‘settle’
	/gaʃ/	[gaʃ]	‘luggage’
	/gɑlb/	[gɑlˤbˤ]	‘heart’
	/gɑsˤɨr/	[gɑsˤɨrˤ]	‘palace’
HA syllable patterns			
Light	/ma.ra/	[mˤɑ.rˤɑ]	‘a woman’
	/gah.wa/	[gha.wa]	‘coffee’
	/ka.bat/	[ka.bat]	‘closet’
Heavy	/raɪ/	[raɪ]	‘opinion’
	/ʔiː/	[ʔiː]	‘yes’
	/ʔaː.na/	[ʔɑː.na]	‘I’
	/kaʃ.ta(h)/	[kaʃ.ta(h)]	‘camping’
	/ʧbab.aːt/	[ʧbab.aːt]	‘meatballs’
Superheavy	/fuːt/	[fuːt]	‘wasp’
	/biʃt/	[biʃt]	‘coat’
	/sˤmˤɑːtˤ/	[sˤmˤɑːtˤ]	‘table cover’
Onset consonant clusters in HA			
	/ba.qa.rah/	[bga.rah]	‘cow’
	/si.waː.rah/	[swaː.rah]	‘bracelet’
	/θa.ma.ra.tah/	[θmˤɑrˤ.tah]	‘his fruit’
	/ħi.maːr/	[ħmˤɑːrˤ]	‘donkey’
	/taʕ.luk/	[tʕalʧ]	‘she chews’
	/ʃa.ʤa.rah/	[ʃʤa.rah]	‘tree’
	/wa.ra.qah/	[wri.gah]	‘paper’

	/da.ra.ʤah/	[dri.ʤah]	‘stair’
	/ʕa.ta.bah/	[ʕti.bah]	‘threshold’
	/ħa.da.bah/	[ħdi.bah]	‘protrusionʕ
	/ʤa.ða.bah/	[ʤði.bah]	‘phloem’
	/ħa.la.qah/	[ħli.gah]	‘earing’
	/ma.ra.qah/	[mri.gah]	‘stew’
Metathesis in HA			
	/qah.wah/	[gha.wah]	‘coffee’
	/ʃaʕ.rah/	[ʃʕa.rah]	‘a single hair’
	/naχ.lah/	[nˤχɑ.lˤɑh]	‘palm tree’
	/ʃah.wah/	[ʃha.wah]	‘desire’
	/sˤɑχ.lˤɑh/	[sˤχɑ.lˤɑh]	‘sheep’
Right-most superheavy syllable (CVCC and CVVC) is stressed in HA			
	/biʃt/	[ˈbiʃt]	‘cloak’
	/ʤa.last/	[ʤa.ˈlast]	‘I sat’
	/san.dart/	[san.ˈdart]	‘I froze’
	/baː.laʁt/	[baː.ˈlaqt]	‘I exaggerated’
	/ta.laʕ.θamt/	[ta.laʕ.ˈθamt]	‘I stuttered’
	/ʔin.ta.ʕaʃt/	[ʔin.ta.ˈʕaʃt]	‘I refreshed’
	/zi.biːl/	[zi.ˈbiːl]	‘date basket’
	/bar.daːn/	[bar.ˈdaːn]	‘cold’
	/kaː.buːs/	[kaː.ˈbuːs]	‘nightmare’
	/jad.ri.suːn/	[jad.ri.ˈsuːn]	‘they study’
	/ji.zitˤ.tˤuːn/	[ji.zitˤ.ˈtˤuːn]	‘they devour’
	/jin.tar.koːn/	[jin.tar.ˈkoːn]	‘being left’
	/mu.naː.fa.saːt/	[mu.naː.fa.ˈsaːt]	‘competitions’
	/ni.qaː.ʃaːt/	[ni.qaː.ˈʃaːt]	‘discussions’
The penultimate superheavy syllable CCVVC and CVVC is stressed in HA:			
	/seːr.ha/	[ˈseːr.ha]	‘her belt’
	/daːr.kum/	[ˈdaːr.kum]	‘your room’

	/ʃta.heːt.hum/	[ʃta.ˈheːt.hum]	‘I desired them’
	/tan.nuːr.ti/	[tan.ˈnuːr.ti]	‘my skirt’
	/gduːr.na/	[ˈgduːr.na]	‘our pots’
	/sduːrkum/	[ˈsduːrkum]	‘your chests’
Stress heavy penultimate in HA			
	/kub.ri/	[ˈkub.ri]	‘a bridge’
	/daː.fi/	[ˈdaː.fi]	‘warm’
	/tar.tar/	[ˈtar.tar]	‘sequin’
	/θaː.bit/	[ˈθaː.bit]	‘stable’
	/swaː.ra/	[ˈswaː.ra]	‘a bracelet’
	/θmar.tah/	[ˈθmar.tah]	‘his fruit’
	/ʃʕar.tik/	[ˈʃʕar.tik]	‘your hair’
	/tˤɑ.lˤɑʕ.taj/	[tˤɑ.ˈlˤɑʕ.taj]	‘you exited’
	/ma.χɑː.bi/	[ma.ˈχɑː.bi]	‘pockets’
	/ma.naː.ðˤɨr/	[ma.ˈnaː.ðˤɨr]	‘scenes’
	/ħa.rag.ni/	[ħa.ˈrag.ni]	‘burned me’
	/kin.dar.ti/	[kin.ˈdar.ti]	‘my shoe’
	/mal.guː.fah/	[mal.ˈguː.fah]	‘nosy’
	/ʕaː.ʃuː.ra/	[ʕaː.ˈʃuː.ra]	‘the 10th’
	/ʃar.bak.tik/	[ʃar.ˈbak.tik]	‘I tangled you’
	/mˤɑː.sˤʉː.rɑh/	[mˤɑː.ˈsˤʉː.rɑh]	‘a pipe’
	/mar.ʤuː.ʤah/	[mar.ˈʤuː.ʤah]	‘clumsy’
	/ʃaː.ʕir.kum/	[ʃaː.ˈʕir.kum]	‘your poet’
	/ħin.ʤa.rat.ha/	[ħin.ʤa.ˈrat.ha]	‘her throat’
	/mu.han.di.sat.na/	[mu.han.di.ˈsat.na]	‘our engineer’
	/mi.tˤɑː.biː.ʤah/	[mi.tˤɑː.ˈbiː.ʤah]	‘his boxes’
Stress heavy antepenultimate in HA:			
	/kam.bi.liʧ/	[ˈkam.bi.liʧ]	‘your blanket’
	/gið.li.ti/	[ˈgið.li.ti]	‘my bang’
	/saː.ħi.ti/	[ˈsaː.ħi.ti]	‘my yard’

	/staː.rat.kum/	[ˈstaː.rat.kum]	‘your curtain’
	/kʃeː.ʃat.ha/	[ˈkʃeː.ʃat.ha]	‘her mane’
The effect of the segments /ʁ, χ, q/ on a preceding /s/ in HA			
	/jusɑːquːna/	[jusˤɑːquːna]	‘they are being guided’
	/jusqɑun/	[jʉsˤqɑun]	‘they are offered a drink’
	/jisqɑʕ/	[jɪsˤqɑʕ]/ [jɪsˤɢɑʕ]/	‘crash’
	/busaːq/	[bʉsˤɑːq]/ [bʉsˤɑːɢ]	‘spit’
	/basqɑh/	[bɑsˤqɑh]/ [bɑsˤɢɑh]	‘black rock land’
	/wasχ/	[wɑsˤχ]	‘dirty’
	/sbaχɑh/	[sˤbˤɑχɑh]	‘accumulate minirals’
	/masχɑrɑh/	[mɑsˤχɑrˤɑh]	‘cynicism’
	/siχrah/	[sˤɨχrˤɑh]	‘obediance’
	/masʁɑbah/	[masˤqɑbˤɑh] or [mɑzʁɑbah]	‘starvation’
Additional examples from HA effect of the segment /r/ on a preceding /s/:[63]			
	/sajjarah/	[sˤɑjjɑːrˤh]	‘a car’
	/sabbuːrah/	[sˤɑbˤbˤʉːrˤɑh]	‘board’
	/sirwaːl/	[sˤɪrˤwˤɑːlˤ]	‘trousers’
	/suːrah/	[sˤʉːrˤɑh]	‘Surat’
	/bsirʕah/	[bˤsˤɪrˤʕɑh]	‘quickly’
Additional examples of the status of /ɢ/ and /g/ in HA			
	/giriːb/	[ʤiriːb]	‘nearby’
	/kibiːr/	[ʧibiːr]	‘big / large’
	/rigiːg/	[riʤiːʤ]	‘thin’
	/giblah/	[ʤiblah] / [ʤiblah]	‘west’
	/riglah/	[riglah] / [riʤlah]	hisitant’
	/migbil/	[miʤbil] / [miʤbil]	‘forthcoming’
	/giliːb/	[ʤiliːb] / [ʤiliːb]	‘well’

[63]The emphasis triggered by the secondary emphatic segments such as /r/ is beyond the scope of this research. However, the examples reported here since they are observed during the data collection process.

Emphasis effect triggered by /ɢ/ in HA			
	/ɢalb/	[ɢalˤbˤ]	‘heart’
	/ɢiful/	[ɢɨfˤʉlˤ]	‘lock’
	/sirɢɑh/	[sˤirˤɢɑh]	‘a robbery’
Occurrence of pharyngealised /lˤ/ in HA			
	/χaːl/	[χɑːlˤ]	‘my mother’s brother’
	/χabal/	[χɑbɑlˤ]	‘crazy’
	/ʁalab/	[ʁalˤɑbˤ]	‘he won’
	/ʁala/	[ʁalˤɑ]	‘love’
	/ɢiful/	[ɢɨfʉlˤ]	‘lock’
	/ɢalb/	[ɢalˤbˤ]	‘heart’
	/ɢlaːs/	[ɢlˤɑːsˤ]	‘glass’ (loan word)
Minimal pairs of pharyngealised and plain counterpart segments in HA			
/tˤ/ and /t/	/tˤal/	[tˤɑlˤ]	‘overlook’
	/tat/	[tat]	‘hill’
	/futˤuːr/	[fˤʉtˤʉːrˤ]	‘breakfast’
	/futuːr/	[futuːr]	‘lethargy’
	/bitˤ/	[bˤɨtˤ]	‘hit’
	/bit/	[bit]	‘decide’
/ðˤ/ and /ð/	/faðˤ/	[fˤɑðˤ]	‘rude’
	/fað/	[fað]	‘unique’
	/ðˤaːl/	[ðˤɑːlˤ]	‘remain’
	/ðaːl/	[ðaːl]	‘humiliate’
	/ðˤuruːf/	[ðˤʉrˤʉːfˤ]	‘circumstances’
	/ðuruːf/	[ðuruːf]	‘weeper’
	/ħɑðˤir/	[ħɑðˤɨrˤ]	‘ban’
	/ħaðir/	[ħaðir]	‘caucious’
/sˤ/ and /s/	/raːsˤ/	[rˤɑːsˤ]	‘align’
	/raːs/	[raːs]	‘head’
	/sˤaːl/	[sˤɑːlˤ]	‘attack’

	/saːl/	[saːl]	‘spill’
	/sˤuːr/	[sˤʉːrˤ]	‘horn’
	/suːr/	[suːr]	‘fence’
	/ʕasˤiːr/	[ʕɑsˤɨːrˤ]	‘juice’
	/ʕasiːr/	[ʕasiːr]	‘difficult’
/dˤ/~[ðˤ] and /d/	/ðˤaːr/	[ðˤɑːrˤ]	‘harmful’
	/daːr/	[daːr]	‘house’
	/mafruːðˤ/	[mˤɑfˤrˤʉːðˤ]	‘imposed’
	/mafruːd/	[mafruːd]	‘straightened’
	/jiðˤif/	[jˤɨðˤɨfˤ]	‘overflow’
	/jidif/	[jidif]	‘push’
Uvularisation examples of /χ, ʁ, q, ɢ/ in HA			
	/χal/	[χˤɑlˤ]	‘vineger’
	/ʁal/	[ʁɑlˤ]	‘precious’
	/qaːl/	[qɑːlˤ]	‘exagerate’
	/ɢaːl/	[ɢɑːlˤ]	‘fried’
Emphasis spread at word level in HA with pharyngealised segments			
	/ʕasˤ/	[ʕˤɑsˤ]	‘hard’
	/tˤaːr/	[tˤɑːrˤ]	‘drum’
	/lafðˤ/	[lˤɑfðˤ]	‘pronunciation’
	/ðaːʕ/	[ðˤɑːʕ]	‘lost’
	/ðˤa.laːm/	[ðˤɑ.lˤɑːmˤ]	‘darkness’
	/miħ.maːsˤ/	[miħ.mˤɑːsˤ]	‘pan’
	/ba.laːtˤ/	[bˤ.lˤɑːtˤ]	‘tiles’
	/tˤuː.ba/	[tˤʉː.bˤɑ]	‘brick’
	/mar.ma.tˤa/	[mˤɑrˤ.mˤɑ.tˤɑ]	‘problematic’
	/tˤaːr.bi.ga/	[tˤɑːrˤ.bˤi.ɢɑ]	‘crumbling’
	/mur.ðˤi.ʕa/	[mˤʉrˤ.ðˤɨ.ʕa]	‘wet nurse’
	/sˤuː.ma.ʕa/	[sˤuː.ma.ʕa]	‘room’
Emphasis spread at word level in HA with uvulars			

	/χam/	[χɑmˤ]	‘vacuum’
	/ʁab/	[qɑbˤ]	‘disappear’
	/ʁaʃ/	[qɑʃˤ]	‘cheat’
	/qal/	[qɑl]	‘little’
	/ɢɑm/	[ɢɑmˤ][64]	‘rise’
	/χa.laːl/	[χɑ.lˤɑːlˤ]	‘dates’
	/χa.laɢ/	[χɑ.lˤɑɢ]	‘create’
	/na.χal/	[nˤɑ.χɑlˤ]	‘palmtrees’
	/ʁa.mar/	[qɑ.mˤɑrˤ]	‘fill’
	/la.ʁam/	[la.qɑmˤ]	‘mine’
	/ɢɑ.lam/	[ɢɑ.lˤɑmˤ]	‘pen’
	/qa.laq/	[qɑ.laq]	‘worry’
	/ma.qar/	[mˤɑ.qɑrˤ]	‘headquarters’
	/ɢɑ.laʕ/	[ɢɑ.lˤɑʕ]	‘rip’
	/ʃi.ɢɑl/	[ʃˤɨ.ɢɑlˤ]	‘lift’
	/χaz.bi.ɢa/	[χɑz.bˤɨɢɑ]	‘storm’
	/ʁar.ba.la/	[qɑrˤ.bˤɑ.lˤɑ]	‘trouble’
	/ʁa.maː.ra/	[qɑ.mˤɑː.rˤɑ]	‘backseat’
	/ħa.la.qa/	[ħa.la.qɑ]	‘ring’
	/qa.man.da/	[qɑ.mˤɑnˤ.da]	‘gist’
	/ɢɑ.ram.baʕ/	[ɢɑ.rˤɑmˤ.bˤɑʕˤ]	‘rusty’
Emphasis spread to prefixes and suffixes pharyngealised segments in HA.			
prefix	/ʔa+tˤarrib/	[ʔˤɑ+tˤɑrˤrˤɨbˤ]	‘anounce’
	/ʔa+ratˤtˤib/	[ʔˤɑ+rˤɑtˤtˤɨbˤ]	‘humidify’
	/na+sˤbir/	[nˤɑ+sˤbˤɨrˤ]	‘wait’
	/ja+ðˤmir/	[jˤɑ+ðˤmˤɨrˤ]	‘cover’
suffix	/tˤaːr+ik/	[tˤɑːrˤ+ɨkˤ]	‘your drum’
	/tˤaːr+ha/	[tˤɑːrˤ+hˤɑ]	‘her drum’
	/tˤaːr+na/	[tˤɑːrˤ+nˤɑ]	‘our drum’

[64] The velar /g/ under emphasis spread effect from the adjacent vowels /ɑ, ɨ, ʉ/ surfaces as [ɢ]

	/sˤu:r+ɪk/	[sˤʉ:r+ɪkˤ]	‘your horn’
Emphasis spread to prefixes and suffixes from uvulars in HA.			
prefix	/ja+χlug/	[jˤɑ+χlˤʉɢ]	‘he creates’
	/ ʔa+χabbir/	[ʔˤɑ+χɑbˤbˤɪrˤ]	‘to tell’
	/na+ʁmur/	[nˤɑ+ʁmˤʉrˤ]	‘we fill’
	/ʔa+qassam/	[ʔa+qɑrssam]	‘I devide’
	/ʔa+ɢlaʕ/	[ʔˤɑ+ɢlˤɑʕˤ]	‘I uproot’
suffix	/χalag+ik/	[χɑlˤɑɢ+ɪkˤ]	‘he creates you’
	/buχu:r+ik/	[buχʉ:r+ɪkˤ]	‘your scent
	/ʁamar+hum/	[ʁɑmˤɑrˤ+ hˤʉmˤ][65]	‘he filled them’
	/qassam+na/	[qɑssam+na]	‘we devided’
	/ɢalaʕ+hum/	[ɢɑlˤɑʕˤ+hˤʉmˤ]	‘uproots them’
Post-lexical emphasis spread from pharyngealised segments in HA			
	/ʃa:bbat # tˤibi:nah/	[ʃa:bbatˤ # tˤɪbˤi:nˤɑ]	‘she started a fire’
	/nuwa:fið # ðˤa:kka/	[nuwa:fiðˤ # ðˤɑ:ˤkˤkˤɑ]	‘narrow windows’
	/ħa:ris # sˤa:ħi/	[ħa:risˤ # sˤɑ:ħˤi]	‘alerted guard’
	/ʃam # tˤi:b/	[ʃam # tˤɨ:bˤ]	‘he smelled a perfume’
	/ʔakal # ðˤifra/	[ʔakal # ðˤɪfˤrˤɑ]	‘he ate his nail’
	/limaħ # sˤu:ra/	[limaħ # sˤʉ:rˤɑ]	‘he saw a picture’
No post-lexical emphasis to non- counterparts of the pharyngealised in HA			
	/naʕat # matˤnu:χ/	[naʕat # mˤɑtˤnˤʉ:χ]	‘I qualified a rich man’
	/tilmi:ð # maħðˤu:ðˤ/	[tilmi:ð # mˤɑħˤðˤʉ:ðˤ]	‘a lucky student’
	/ka:s # masˤbu:b/	[ka:s # mˤɑsˤbˤʉ:bˤ]	‘a poured cup’
Blocked progressive post-lexical emphasis in HA			
	/ʔaħitˤ # tamir/	[ʔˤɑħɪtˤ # tamir]	‘I put dates’
	/ʔabi:ðˤ # ðahab/	[ʔˤbˤɨ:ðˤ # ðahab]	‘I lay eggs’

[65] The examples [nˤɑ+ʁmˤʉrˤ] and [ʁɑmˤɑrˤ+ hˤʉmˤ] are presented here to show the emphasis spread triggered by the uvular segment /ʁ/ in HA. However, the final output forms would be [nˤɑ+qmˤʉrˤ] and [qɑmˤɑrˤ+ hˤʉmˤ] as a result of alternation from /ʁ/ to [q] in HA. The alternation between the uvulars /ʁ/ and /q/ is discussed in chapter 5.

	/faħsˤ # saliːm/	[fˤɑħˤsˤ # saliːm]	‘intact examination’
Blocked post-lexical emphasis spread from uvulars in HA			
Regressive	/zaχ # ʃamma/	[zˤɑχ # ʃamma]	‘he took Shamma’
	/farraʁ # sajjaːrta/	[fˤarˤrˤɑʁ # sajjarta]	‘he emptied his car’
	/waθθaq # tasliːma/	[waθθɑq # tasliːma]	‘he recorded his submission’
	/ħarag # beːta/	[ħarˤɑɢ # beːta]	‘he burnt his house’
Progressive	/mattar # ʁurfiti/	[mattar # ʁurˤfˤitˤi]	‘he measured my room’
	/killiʃ # χabal/	[killiʃ # χɑbˤɑlˤ]	‘very crazy’
	/sakkarat # qanaːta/	[sakkarat # qɑnaːta]	‘his channel closed’
	/kisab # ɢalbi/	[kisab # ɢalˤbˤi]	‘he won my heart’
Direction of emphasis spread of the pharyngealised segments in HA			
Regressive	/ʕabatˤ/	[ʕɑbˤɑtˤ]	‘stupidity’
	/lafðˤ/	[lˤɑfˤðˤ]	‘pronunciation’
	/ħatˤ/	[ħˤɑtˤ]	‘put’
	/ħariːsˤ/	[ħarˤiːsˤ]	‘keen’
Progressive	/tˤaːr/	[tˤɑːrˤ]	‘drum’
	/tˤaːl/	[tˤɑːlˤ]	‘overdue’
	/ðˤaːʕ/	[ðˤɑːʕˤ]	‘lost’
	/sˤaːʤ/	[sˤɑːʤˤ]	‘grill’
Bidirectional	/matˤ.juːr/	[mˤɑtˤ.ʉːrˤ]	‘reckless’
	/matˤ.buːʕ/	[mˤɑtˤ.bˤʉːʕˤ]	‘printed’
	/maʕ.tˤuːb/	[mˤɑʕˤ.tˤʉːbˤ]	‘ruined’
	/mas.tˤuːl/	[mˤɑsˤ.tʉːlˤ]	‘drunk’
	/mas.tˤuːr/	[mˤɑsˤtˤʉːrˤ]	‘lined up’
	/maðˤ.muːn/	[mˤɑðˤ.mˤʉːnˤ]	‘guaranteed’
	/man.ðˤuːr/	[mˤɑnˤ.ðˤʉːrˤ]	‘perspective’
	/masˤ.duːm/	[mˤɑsˤ.dʉːmˤ]	‘shocked’
	/maf.sˤuːl/	[mˤɑfˤ.sˤʉːlˤ]	‘detached’
Double emphasis source of the pharyngealised segments in HA			
Bidirectional	/muðˤ.tˤar/	[mˤʉðˤ.tˤɑrˤ]	‘forced’

	/maðˤ.buːtˤ/	[mˤɑðˤ.bʉːtˤ]	‘exact’
	/musˤ.tˤaf/	[mˤʉsˤ.tˤɑfˤ]	‘aligned’
Direction of emphasis spread of the uvular segments in HA			
Regressive	/raχ/	[rˤɑχ]	‘luxurious’
	/ʔaːχ/	[ʔˤɑːχ]	‘hurt’
	/dlaːʁ/	[dˤlˤɑːʁ]	‘a sock’
	/ʃu.ruːq/	[ʃʉrˤʉːq]	‘sunrise’
	/maraɢ/	[mˤɑrˤɑɢ]	‘stew’
	/baɢ/	[bˤɑɢ]	‘pale’
Progressive	/χam/	[χɑmˤ]	‘vacuum’
	/ʁab/	[qɑbˤ]	‘disappear’
	/qanʃa/	[qɑnˤʃˤɑ]	‘a serving dish’
	/ɢarm/	[ɢɑrˤmˤ]	‘chivalrous’
Bidirectional	/ra.ʁi/	[rˤɑ.qɨ]	‘weeping’
	/ma.qar/	[mˤɑ.qɑrˤ]	‘headquarters’
	/maɢ.lab/	[mˤɑɢ.lˤɑbˤ]	‘a prank’
No opaque segments of pharyngealised /tˤ, ðˤ, sˤ/ in HA			
/j/	/tˤajjaːt/	[tˤajˤjˤɑːtˤ]	‘layers’
	/ðˤaːjf/	[ðˤɑːjˤɨfˤ]	‘guest’
	/sajtˤar/	[sˤajˤtˤɑrˤ]	‘dominate’
/ʃ/	/tˤaʃʃar/	[tˤɑʃˤʃˤrˤ]	‘splash’
	/batˤʃa/	[bˤɑtˤʃˤɑ]	‘Caesarian’
	/ʔaʃtˤar/	[ʔˤʃˤtˤɑrˤ]	‘the best’
/w/	/sˤuwaːmiʕ/	[sˤʉwɑːmɨʕˤ]	‘rooms’
	/ʔatˤwaːr/	[ʔˤɑtˤwˤɑːrˤ]	‘stages’
	/ʔawðˤaːʕ/	[ʔˤɑwˤðˤɑːʕˤ]	‘situations’
/i/	/ðˤifir/	[ðˤɨfˤɨrˤ]	‘nail’
	/sˤifir/	[sˤɨfˤɨrˤ]	‘zero’
	/nitˤaħ/	[nˤɨtˤɑħˤ]	‘gore’
/iː/	/sˤiːn/	[sˤɨːnˤ]	‘China’

	/ʕasˤiːr/	[ʕˤɑsˤɨːrˤ]	‘juice’
	/biːtˤaːr/	[bˤɨːtˤɑːrˤ]	‘veterinarian’
/u/	/ðˤulm/	[ðˤʉlˤmˤ]	‘injustice’
	/sˤuk/	[sˤʉkˤ]	‘close’
	/futˤar/	[fˤʉtˤɑrˤ]	‘breakout’
No opaque segments of uvular segments /χ, ʁ, q, ɢ/ effect in HA			
/j/	/ʁaːjib/	[ʁɑːjˤbˤ]	‘absent’
	/faːjiχ/	[fˤɑːjˤɨχ]	‘annoyed’
	/ɢajmar/	[ɢɑjˤmˤɑrˤ]	‘cream’
/ʃ/	/qrʉːʃ/	[ɢrˤʉːʃ]	‘coins’
	/ʁaʃmara/	[ʁɑʃˤmˤɑrɑ]	‘joking’
	/ʃaχ/	[ʃˤɑχ]	‘pee’
/w/	/qawam/	[qɑwɑːmˤ]	‘figure’
	/ʔawrɑːq/	[ʔˤɑwˤrˤɑːɢ]	‘papers’
	/zawaʁ/	[zˤɑwˤɑʁ]	‘deflected’
/i/	/laːʁi/	[lˤɑːʁɨ]	‘cancelled’
	/ɢibaʕ/	[ɢɨbˤɑʕ]	‘spread’
	/zibaχ/	[zˤɨbˤɑχ]	‘lie’
/iː/	/χiːra/	[χɨːrˤɑ]	‘goodness’
	/raqiːq/	[rˤɑqɨːq]	‘tender’
	/rˤiːɢ/	[rˤɨːɢ]	‘saliva’
/u/	/χubar/	[χʉbˤɑrˤ]	‘Khobar’
	/buɢɑr/	[bˤʉɢɑrˤ]	‘cows’
Alternation of uvular segments /q/ and /ʁ/ in HA			
No change of [q] in HA			
a. /q/ adjacent to voiceless obstruent segments			
	/mʉqtaraħ/	[mʉqtaraħ]	‘suggestion’
	/ʔitqɑːn/	[ʔitqɑːn]	‘perfection’
	/wɑqħɑ/	[wɑqħɑ]	‘shameless’
b. /q/ adjacent to a pharyngealised segment			

	/ʔɑqsˤʁrˤ/	[ʔɑqsˤʁrˤ]	‘truncated’
	/taqðˤɨ/	[tɑqðˤɨ]	‘compensate’
	/bˤɑtˤrˤiːq/	[bˤɑtˤrˤiːq]	‘penguin’
	/mˤɑqtˤʉːrˤɑ/	[mˤɑqtˤʉːrˤɑ]	‘trailer’
	/qɑjsˤɑrˤ/	[qɑjsˤɑrˤ]	‘Caesar’
	/qɨsˤsˤɑ/	[qɨsˤsˤɑ]	‘story’
c. /q/ adjacent to a back vowel /ɑ/ and /ʉ/			
	/qʉdra/	[qʉdra]	‘ability’
	/qɑsam/	[qɑsam]	‘swear’
	/wˤɑqʉːrˤ/	[wˤɑqʉːrˤ]	‘dignified’
	/mʉqɑːrˤɑnah/	[mʉqɑːrˤɑnah]	‘comparison’
	/qɑrˤɑːrˤ/	[qɑrˤɑːrˤ]	‘decision’
	/fˤɑqɨːrˤɑ/	[fˤɑqɨːrˤɑ]	‘poor’
Voicing of /q/ to [ɢ] in HA as a result to an assimilation to a voiced adjacent segment			
	/ʕqɑːlˤ/	[ʕɢɑːlˤ]	‘male head piece’
	/bˤʉqʕɑ/	[bˤʉɢʕɑ]	‘a stain’
	/bˤqɑrˤɑ/	[bˤɢɑrˤɑ]	‘a cow’
	/χɑlˤq/	[χɑlˤɢ]	‘creatures’
	/qmˤɑːʃ/	[ɢmˤɑːʃ]	‘textile’
	/lˤʉqmˤɑ/	[lˤʉɢmˤɑ]	‘a bite’
Voicing + spirantisation of /q/ to [ʁ] in HA			
	/tɑqrɨːban/	[tɑʁrɨːban]	‘almost’
	/fˤɑqrˤɑ/	[fˤɑʁrˤɑ]	‘a paragraph’
No change of [ʁ] in HA			
	/tɑʁrˤɨːd/	[tɑʁrˤɨːd]	‘tweet’
	/mˤɑʁrˤɨb/	[mˤɑʁrˤɨb]	‘a paragraph’
Fortition by devoicing and manner of articulation change of /ʁ/ to [q] in HA			
a. /ʁ/ → [q] in consonant clusters or CC sequences			
	/ʁlɨgɑ/	[qlɨɢɑ]	‘depression’
	/lʁʉːd/	[lqʉːd]	‘jowls’

	/sˤɑmˤʁ/	[sˤɑmˤq]	‘glue’
	/ʁtˤɑrˤrˤ/	[qtˤɑrˤrˤ]	‘male head wear’
b. /ʁ/→ [q] in a pharyngealisation environment			
	/ðˤɑʁtˤ/	[ðˤɑqtˤ]	‘pressure’
	/bˤʉʁðˤ/	[bˤʉqðˤ]	‘detest’
	/sˤʁɨːrˤ/	[sˤqɨːrˤ]	‘little’
	/ʁɑmˤɨːðˤɑ/	[qɑmˤɨːðˤɑ]	‘regrettably’
c. /ʁ/ → [q] in onset position			
	/ʁɑlɑ/	[qɑlˤɑ]	‘precious’
	/ʁɨːrˤɑ/	[qɨːrˤɑ]	‘jealousy’
	/ʁɑːzi/	[qɑːzi]	‘warrior’
	/ʁʉrˤfˤɑ/	[qʉrˤfˤɑ]	‘room’
	/ʁɑbˤrˤɑ/	[qɑbˤrˤɑ]	‘irritant’
/g/ → [ɢ] in a pharyngealised environment in HA in the vicinity of the back vowel /ɑ/			
	/gʉmˤɑrˤ/	[ɢʉmˤɑrˤ]	‘moon’
	/gɑːrˤɑ /	[ɢɑːrˤɑ]	‘historical mountain’
	/ʃɨgɑfˤ/	[ʃɨɢɑfˤ]	‘pieces’
	/gɑrˤɑʕ/	[ɢɑrˤɑʕ]	‘squash’
	/gɑːmˤ/	[ɢɑːmˤ]	‘he rose’
	/gɨðlah/	[ɢɨðˤlah]	‘bangs’
	/gɨmt/	[ɢɨmˤt]	‘I stood up’
Examples of /q/, /ʁ/, /χ/ and /g/ as phonemic segments in HA			
/q/	/qɑʃˤ/	[qɑʃˤ]	‘straw’
/ʁ/	/ʁɑʃˤ/	[ʁɑʃˤ]/ [qɑʃˤ]	‘cheat’[66]
/χ/	/χɑʃˤ/	[χɑʃˤ]	‘hide’
/g/	/gɑʃˤ/	[gɑʃˤ]	‘luggage’
More examples of aternation between uvulars /ʁ/ → [q] in HA			

[66] This note is repeated here for extra clarification of this example, as a preserved /ʁ/ may ONLY occur in formal situation. However, after careful and further discussion with speakers of the same dialect, the output of /ʁɑʃˤ/ is actually [qɑʃˤ] in HA.

	/ʁɑb/	[qɑbˤ]	‘disappear’
	/rɑʁi/	[rˤɑqɨ]	‘weeping’
	/ʁɑːjib/	[qɑːjˤbˤ]	‘absent’
	/ʁɑʃmara/	[qɑʃˤmˤarɑ]	‘joking’
	/zawwɑʁ/	[zˤɑwˤwˤɑq]	‘deflected’
	/nɑʁmah/	[nˤɑqmˤɑh]	‘a tone’
	/ʁɑmaːrah/	[qɑmˤɑːrɑˤh]	‘one row’
	/tˤʁjaːn/	[tˤʁjɑːnˤ]	‘tyranny’
	/ʁɑʃiːmah/	[qɑʃˤɨːmˤɑh]	‘stupid’
	/ʔɑʁsˤɑːn/	[ʔˤɑʁsˤɑːnˤ]	‘branches’
	/ʔɨʁtisaːl/	[ʔɨqtisaːl]	‘washing’
	/farɑːʁ/	[fɑrɑːq]	‘emptiness’
	/ʁɑflah/	[qɑfˤlˤɑh]	‘negligence’
	/ʔɑʁrɑːb/	[ʔˤɑqrˤɑːbˤ]	‘strangers’
	/jɑʁmur/	[jˤɑqmˤʁrˤ]	‘fill up’
	/ʁʁrrah/	[qʁrˤrˤɑh]	‘bangs’
	/laθʁah/	[lɑθqɑh]	‘a lisp’
	/mʁɑbʃah/	[ʔɨmqɑbˤʃɑh]	‘fussy’
	/miŋʁɑr/	[mˤɨŋqɑrˤ]	‘cocky’
	/ladʁah/	[lˤɑqɑh]	‘a sting’
Assimilation between uvular segments in HA at the phrasal level			
	/ʃmaːʁ # χalaf/	[ʃˤmˤɑːχ # χɑlˤɑfˤ]	‘Khalaf’s headdress’
	/salχ # ʁaːliː/	[sˤɑlˤʁ # ʁɑːlˤɨː]	‘very expensive’
	/ʔinzilaːq # ʁuðˤruːfi/	[ʔinzilaːq # qʁðˤrˤʁːfˤɨ]	‘herniated disc’
	/zaːʁ # ɢalbi/	[zˤɑːɢ # ɢɑlˤbˤɨ]	‘deflected my heart’

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