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Vowel Length/ Duration in Geminated and Non-geminated Arabic Words

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Abstract

This paper investigates vowel length in Arabic and how it gets affected by neighboring consonants, in particular when it occurs in geminated or non-geminated phonetic environment in words. The paper examines vowel length before and after geminated and non-geminated consonants. It also focuses on the length of geminated/non-geminated consonants themselves and the proportion between them. The present study also investigates the proportion of vowels to consonants in the words and the proportion of geminated words to their non-geminated counterparts as a whole. Eighteen geminated and non-geminated Arabic words are selected and recorded randomly by the researcher who is a native speaker of Arabic. The data were recorded at the Phonetics Lab of the English and Foreign Languages University in Hyderabad/India. It was concluded that gemination in Arabic affects vowel and consonants as well as total length/ duration of the word as a whole. It is also observed that some vowels/ consonants have greater proportion than their non-geminated counterparts. The whole words were also affected by germination in terms of length and duration.

Keywords: Duration, Gemination , Arabic,Vowels, consonants, Acoustic analysis.

1. Introduction

Arabic is the mother tongue of over 400 million people. Modern Standard Arabic (MSA) _ the descendant of Classical Arabic branches into 22 vernacular dialects in the 22 Arab countries, each country having its own regional vernacular variety *(Humran.A and Shyamala.K.C. 2018).* It has a large inventory of 28 consonants plus 6 vowels.

In Arabic, gemination can be defined as a cluster of two identical consonants and it is marked with a diacritic called the shadda (شدة) which should be written above the consonant that is to be doubled .Gemination is a distinctive feature in Arabic and it is used to achieve a lexical, grammatical, contrastive or emphatic function .When consonants are geminated, they tend to be longer in length and duration than those non-geminated and the neighboring sounds in the word. This may affect the preceding and following vowels and consonants. This paper is therefore dealing with vowel length in certain phonetic environment and how they behave in geminated and non- geminated words in Arabic phonology.

2. Literature Review

Many studies have been conducted on the relationship between vowels length and consonant germination in many languages including English, Swedish, Japanese and many other languages. Maddieson (1985) studied "Phonetic Cues of Syllabification" in Kannada, Tamil, Telugu, Hausa, Italian, Icelandic, Norwegian, Finnish, Hungarian, Arabic, Shilah, Amharic, Galla, Dogri, Bengali, Sinhalese and Rembarranga. He collected and examined data from different speakers and concluded that vowels get shorter before germination than before single consonant. Kaori Idemaru & Susan G. Guion (2008), in their study Acoustic Covariants of Length Contrast in Japanese Stops, pointed out that vowels which precede geminated consonants tend to be longer than those preceding non-

geminated ones. They also found out that vowels following geminated consonants tend to be shorter and confirmed that more creakiness was observed in voice quality for geminated than singleton consonants.

Concerning Arabic, a number of studies were carried out on gemination either in Standard Arabic or in other dialectal varieties of Arabic such as Lebanese, Iraqi, Yemeni and Jordanian. To the best of my knowledge, few were conducted on the influence of germination on the neighboring segments in terms of vowels duration on the basis of acoustic analysis. Aymen, Mohsen & Mounir (2010) investigated the effect of gemination on the duration of consonants and vowels in standard Arabic and found out that the duration of simple consonants is different from that of their geminated counterparts since the geminated tend to be longer. The difference is also observed in the duration of vowel preceding the geminated consonant as was shown by the statistical results they obtained from the acoustic analysis they got using Praat software program. In their experimental study of the acoustic and articulatory features of the gemination in Modern Arabic language pronounced by Algerian speakers, Ferrat & Guerti (2017) noted that the respective durations of the preceding vowels of the geminate consonant are significantly different compared to their counterparts in non-geminate context. The gemination influences the duration of the preceding vowel by decreasing its value and the duration of the following vowel by increasing its value. In addition, there is a decreasing in levels of F1 and F2 formants and a rising in level of F3 formant of the following vowel.

In the current paper, eighteen Arabic words containing geminated and non-geminated consonants were recorded by the researcher, A Yemeni speaker of Arabic. The recorded data were acoustically analyzed to find out how germination in Arabic affects the length of vowels and consonants as well as total length/ duration of the word as a whole.

3. Study

3.1 Aims of This Paper

This research is undertaken to answer the following three questions

i. Does vowel get lengthened/prolonged before and after geminated and non-geminated consonants?
ii. If there is a difference in vowel lengthening between geminated and non-geminated consonants, what is the proportion of that difference?
iii. What is the total proportion of consonants to vowels duration in geminated/ non-geminated words? And what is the proportional duration of non-geminate to geminated words as a whole?

3.2 Instruments Used

In conducting the acoustic analysis, this researcher makes use of Spectrograph (a machine for recording spectra producing spectrogram) in order to arrive at acoustic evidence that is expected to realize the above research questions. Eighteen geminated and non-geminated Arabic words are selected and recorded randomly by the researcher who is a native speaker of Arabic. The data were recorded at the Phonetics Lab of the English and Foreign Languages University in Hyderabad/India. A spectrograph of a high quality was used to record the words and getting a clear spectrogram for each word.

The following table shows the data used by the researcher in this paper:

Table1.

Non-geminated word	Transcription	Translation	Geminated word	Transcription	Translation
Gamal	/gamal/	camel	gammal	/gammal/	beautify
Garaħ	/garaħ/	hurt	garraħ	/garraħ/	defame
Rokaab	/rokaab/	herd of camels	rokkaab	/rokkaab/	passengers
roqaʕ	/roqaʕ/	piece	roqqaʕ	/roqqaʕ/	stitched
Salam	/salam/	intact	sallam	/sallam/	surrender
qɪtaal	/qɪtaal/	fighting	qɪttaal	/qɪttaal/	massacre
khotˁa	/χotˁa/	steps	khotˁtˁa	/χotˁtˁa/	Plan
kɪbaar	/kɪbaar/	very big	kɪbbaar	/kɪbbaar/	enlargement
Kafar	/kafar/	disbelieve	kaffar	/kaffar/	atone

3.4 Data Analysis and Interpretation

The following table shows all the words recorded along with their length/ duration.

Table2.

	Non-geminated							**Geminated**					
Word	**g**	**a**	**m**	**a**	**l**	**total**	**Word**	**g**	**a**	**mm**	**a**	**l**	**total**
Length	**33**	**45**	**15**	**43**	**38**	**174**	**Length**	**27**	**17**	**45**	**22**	**40**	**151**
Duration	**122**	**166**	**55**	**159**	**140**	**642**	**Duration**	**180**	**113**	**300**	**146**	**266**	**1005**
Word	**k**	**a**	**f**	**a**	**r**		**Word**	**k**	**a**	**ff**	**a**	**r**	
Length	**10**	**35**	**28**	**50**	**30**	**153**	**Length**	**10**	**25**	**48**	**40**	**40**	**163**
Duration	**42**	**147**	**117**	**210**	**126**	**642**	**Duration**	**50**	**125**	**240**	**200**	**200**	**815**
Word	**k**	**ɪ**	**b**	**aa**	**r**		**Word**	**k**	**ɪ**	**bb**	**aa**	**r**	
Length	**10**	**18**	**20**	**90**	**10**	**148**	**Length**	**10**	**10**	**50**	**70**	**10**	**150**
Duration	**52**	**95**	**105**	**475**	**52**	**779**	**Duration**	**57**	**57**	**287**	**401**	**57**	**859**
Word	**χ**	**o**	**tˁ**	**a**			**Word**	**χ**	**o**	**tˁtˁ**	**a**		
Length	**53**	**28**	**30**	**60**		**171**	**Length**	**47**	**18**	**53**	**40**		**158**
Duration	**187**	**99**	**105**	**211**		**603**	**Duration**	**238**	**91**	**268**	**202**		**800**
Word	**q**	**ɪ**	**t**	**aa**	**l**		**Word**	**q**	**ɪ**	**tt**	**aa**	**l**	
Length	**10**	**18**	**28**	**86**	**35**	**177**	**Length**	**10**	**12**	**60**	**75**	**32**	**189**
Duration	**41**	**74**	**115**	**355**	**144**	**729**	**Duration**	**43**	**52**	**260**	**325**	**138**	**818**
Word	**s**	**a**	**l**	**a**	**m**		**Word**	**s**	**a**	**ll**	**a**	**m**	
Length	**45**	**33**	**13**	**32**	**37**	**160**	**Length**	**40**	**18**	**45**	**25**	**43**	**171**
Duration	**188**	**138**	**54**	**134**	**154**	**668**	**Duration**	**221**	**99**	**248**	**138**	**237**	**943**
Word	**r**	**o**	**q**	**a**	**ʕ**		**Word**	**r**	**o**	**qq**	**a**	**ʕ**	
Length	**20**	**40**	**27**	**60**	**25**	**172**	**Length**	**25**	**20**	**40**	**32**	**28**	**145**
Duration	**69**	**137**	**93**	**206**	**86**	**591**	**Duration**	**160**	**128**	**256**	**205**	**179**	**928**
Word	**r**	**o**	**k**	**aa**	**b**		**Word**	**r**	**o**	**kk**	**aa**	**b**	

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Length	**20**	**20**	**25**	**68**	**47**	**180**	**Length**	**15**	**13**	**40**	**57**	**30**	**155**
Duration	**73**	**73**	**92**	**249**	**172**	**659**	**Duration**	**97**	**84**	**258**	**368**	**193**	**1000**
Word	**g**	**a**	**r**	**a**	**ħ**		**Word**	**g**	**a**	**rr**	**a**	**ħ**	
Length	**32**	**32**	**10**	**33**	**55**	**162**	**Length**	**45**	**22**	**40**	**32**	**32**	**171**
Duration	**178**	**178**	**56**	**183**	**306**	**901**	**Duration**	**250**	**122**	**222**	**178**	**178**	**950**

Length in millimetre and time in millisecond.

4. Disscusion and Conclusion

A) Vowel duration before and after geminated and non-geminated consonants:

The phonetic context here is: C**VCV**C versus C**VCCV**C.

From the above table, we can conclude that vowel preceding a non-geminated consonant is longer than that which precedes the geminated consonant .For example, Length of the vowel / a / preceding the single consonant /m/ in the word *gamal* is 45mm and the duration is 166msec ,while in the word *gammal*, we find that the length of the vowel /a/ that precedes the geminated consonant /mm/ is 17mm and the duration is 113msec (see table2). This is due to germination which causes the preceding vowel to shorten in length, hence duration. It is also obvious that the vowel following the geminated consonant is shorter than that which follows a non-geminated consonant. In the example mentioned above, we find that the length of the vowel / a / which follows the single consonant / m / is 43 mm and the duration is 159msec, while the length of the vowel following the geminated consonant / mm / is 22mm and the duration is 146 msec (see table2).

b) The duration of geminated and non-geminated consonants and the Proportion between them:

Here we can clearly see that geminated consonants are longer than non-geminated. The proportion is shown in the following table:

Table 3.

Geminate	Duration in msec	Non-geminate	Duration	Proportion
mm	222	m	55	4.4:1
ff	240	f	117	2.3:1
bb	287	b	105	2.7:1
tˁtˁ	268	tˁ	109	2.5:1
tt	260	t	115	2.4:1
ll	248	l	54	4.3:1
qq	256	q	93	2.7:1
kk	258	k	93	2.7:1
rr	300	r	56	5.4:1

This table shows that geminate proportion to non-geminate is almost 2:1.That is a geminate consonant is twice longer than its non-geminate counterpart. We also observe that sometimes the geminate lateral /ll/ and the bilabial nasal /mm/ are 4 times longer than the non-geminate ones(see figures 1&2 below) .As for geminate /rr/ it is 5 times longer than its peer/r/ and it is trill here(see figure 3).

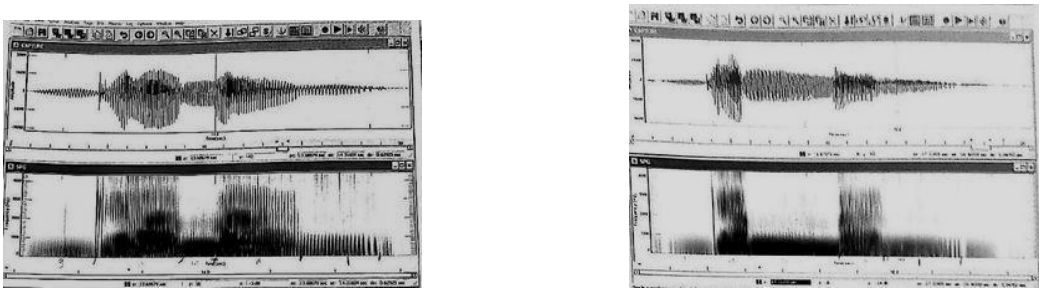


Figure1.Representation of the spectrums and formants for the words / gamal / and / gammal /.

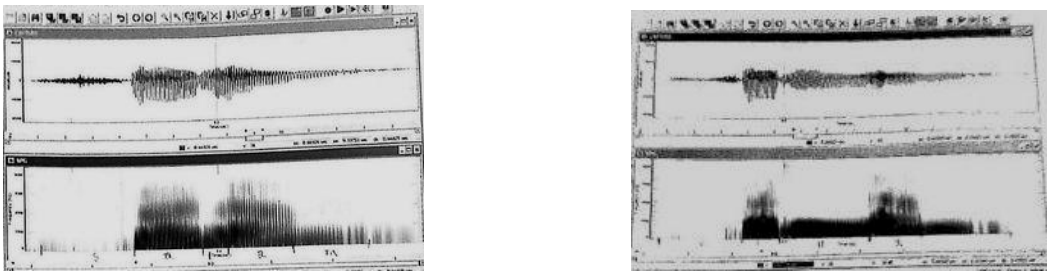


Figure2.Representation of the spectrums and formants for the words / salam / and / sallam /.

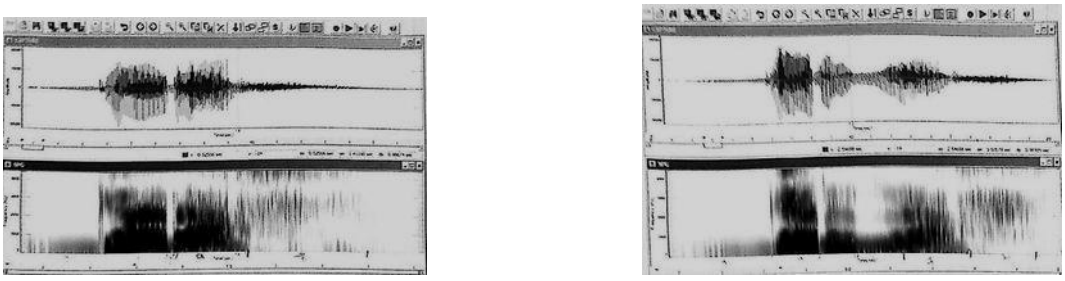


Figure3.Representation of the spectrums and formants for the words / garaħ / and / garraħ/.

C) The proportion of consonants to vowels on the word (geminated or non-geminated) as well as proportion of non-geminate to geminated word as a whole are shown in the following table:

Non-geminated word	consonants	vowels	Grand total	proportion	Geminated word	Con-sonants	vowels	Grand total	Proportion	Grand total proportion
/ɡamal/	317	325	642	1.1:1.2	/gammal	746	259	1005	6.2:1.3	1.4:2
/kafar/	285	357	642	1.7:2.5	/kaffar/	490	325	815	2.3:1.1	1:2
/kɪbaar/	209	570	779	1.1:4.7	/kɪbbaar/	401	458	859	1:1.6	1.1:1.2
/χotˁa/	296	310	603	1.9:2.1	/χotˁtˁa/	506	293	800	4:1.9	1:2
/qɪtal/	300	429	729	1:2.3	/qɪttal/	441	377	818	2.1:1.2	1.1:1.4
/salam/	396	272	668	2.3:1.1	/sallam/	706	237	943	5.1:1.6	1.2:2.1
/roqaʕ/	248	343	591	1.1:2.1	/roqqaʕ/	595	333	928	2.3:1.1	1.3:3:1
/rokab/	338	322	659	1.2:1.1	/rokkab/	548	452	1000	2.1:1.2	1.3:3
/garaħ/	540	361	901	4.2:1.3	/garraħ/	650	300	950	2.5:1	1:1.5

From the details shown in the above table we can conclude the following:

First:

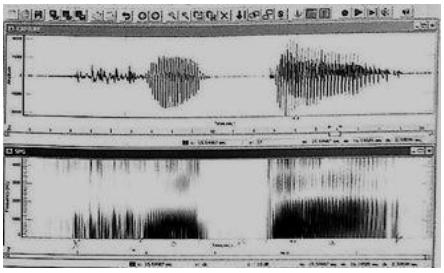
Proportion of consonants to vowels in non-geminated words:

Here we can see that the proportion of consonants to vowels ranges mostly between 1 and 2. We can also observe that fricatives /s / in /*salam*/ makes the range twice longer in proportionate to the range of vowels. This also applies to /*garaħ*/ where /ħ/ makes consonant proportion longer than that of vowels.

Second:

Proportion of consonants to vowels in geminated words:

Here the proportion is dominantly 2 to 1. but sometimes it drifts from 4 to 1 in pharyngealized alveolar plosive /tˤtˤ/ (see figure 4).In geminated lateral /ll/ (see figure2) it ranges from 5 to 1.but the greater range occurs with bilabial nasal /mm/ where it ranges from 6 to 1 (see figure1).



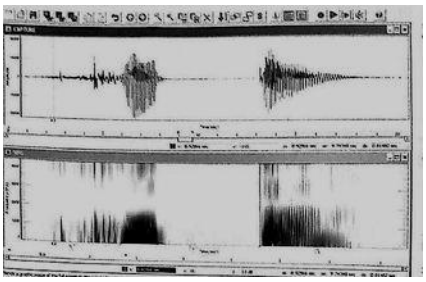
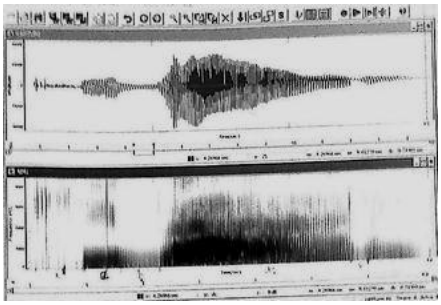


Figure4.Representation of the spectrums and formants for the words / χotˤa / and / χotˤtˤa/.

Third:

Proportion of non-geminated to geminated words as a whole:

Here the proportion ranges is from 1:1,1:2,1:3 and 1:4. We can obviously see that the proportion of words containing plosives /bb/and /tt/ and the approximant /rr/ (non-geminate to geminate) is roughly 1:1.Words (non-geminate to geminate) containing bilabial nasal /mm/ fricative /ff/,pharyngealized alveolar/tˤtˤ/ and lateral / ll/ proportion is 1:2. Words (non-geminate to geminate) containing velar/kk/and uvular /qq/ proportion is 1:3.



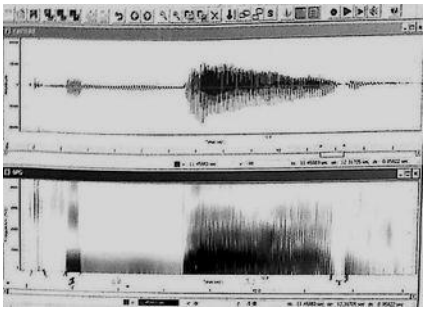
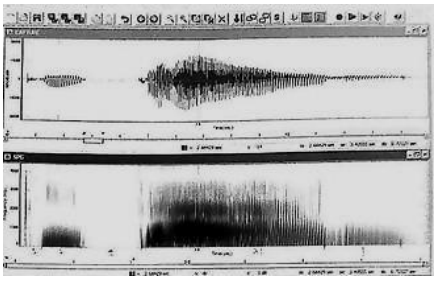


Figure5.Representation of the spectrums and formants for the words / kıbaar / and / kıbbaar /.



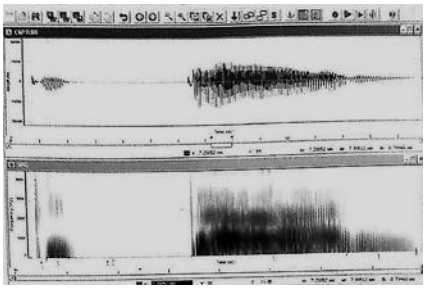
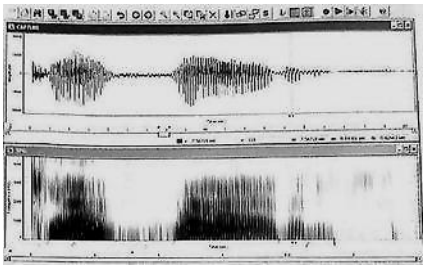


Figure6.Representation of the spectrums and formants for the words / qitaal / and / qittaal /



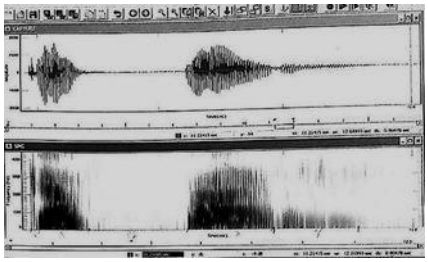
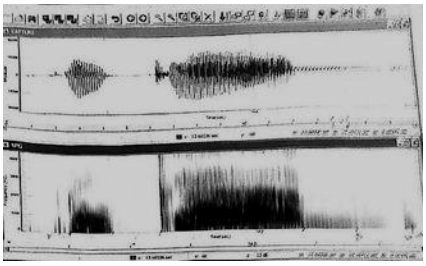


Figure7.Representation of the spectrums and formants for the words / kafar / and / kaffar /.



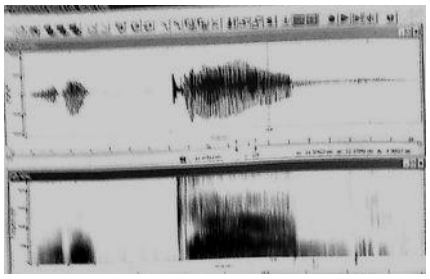
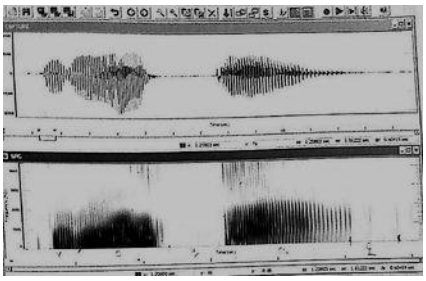


Figure8.Representation of the spectrums and formants for the words / rokaab / and / rokkaab /.



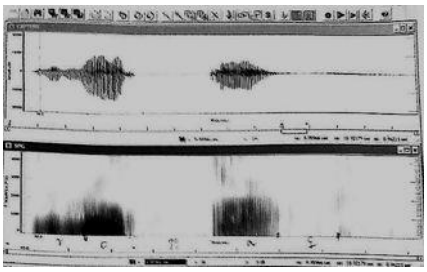


Figure9.Representation of the spectrums and formants for the words /roqaʕ/ and /roqqaʕ/

Based on the above input, analysis and discussion, we can **conclude** that gemination is a phonological process in Arabic whereby words get affected internally in terms of length and duration. However, gemination occurs only in consonants in Arabic but it can influence both vowels and consonants in terms of length and shortness.

5. Limitation of the Study

The current study is limited to the study of vowel length/duration before and after geminated and non-geminated consonants in Arabic. The words used in this study are spoken in both, Standard Arabic and Yemeni Arabic .Other Arabic varieties are not concerned with. It also have focused on length/duration of geminated and non-geminated consonants and the proportion between them in addition to figuring out the proportion of consonants to vowels in the geminated/ non-geminated words as well as proportion of non-geminated to geminated words as a whole. Eighteen words were recorded by one female participant, the researcher who is a native speaker of Yemeni Arabic.

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