Arab World English Journal
INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327
مجلة اللغة الانكليزية في العالم العربي

Arab World English Journal (AWEJ).Vol.6 No.1.2015

Pp.335-358

DOI: https://dx.doi.org/10.24093/awej/vol6no1.26

The Impact of Geminates on the Duration of the Preceding and Following Vowels in Ta'zi Dialect

Nadhim Abdulamalek Aldubai
Department of Languages & Translation
Taibah University, Saudi Arabia

Abstract

This paper is a spectrographic analysis of the duration of geminate consonants and their impacts on the preceding and the following vowels in Ta'zi Dialect (TD), a prominent dialect of the Yemeni Arabic. More than fifty words comprising minimal words are collected from the TD to find out the difference in length between the geminated and the non-geminated consonants in words and the consequences of this process. It has been reached to the conclusion that the duration of the geminate consonant in TD is generally twice as much as that of the non-geminates. When geminated, the trill has been found to be the longest among all other consonants; pharyngeals and semivowels have been found to be the shortest. The voiceless consonants prove to be longer than their voiced counterparts. It is also observed that the geminated consonants affected the preceding and the following vowels. The adjacent vowels to the geminates are generally shortened. It seems that there is no proof that the secondary articulation affects the length of the geminated words in case of gutturals.

Keywords: Duration, geminates, spectrographic analysis, Ta'izi Dialect, vowels,

Cite as: Aldubai, N. A. (2015). The Impact of Geminates on the Duration of the Preceding and Following Vowels in Ta'zi Dialect. *Arab World English Journal, 8* (1).
DOI: https://dx.doi.org/10.24093/awej/vol6no1.26

1.1 Introduction

Gemination (*tashdeed in Arabic*) is generally defined as a sequence of two juxtaposed consonants in a single morpheme. There are vague or contradictory descriptions of 'gemination' in phonetic literature. Hartman, and Strok, (1972:93) defines gemination phonetically as a "sequence of identical adjacent segments of articulations.

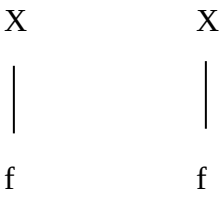
Some phoneticians view geminates as long sounds on the phonetic level, Ladefoged and Maddieson (1996); Ball and Rahilly (1999). This long consonant is corresponding to singletons in Italian (Esposito and Benedetto 1999), Pattani Malay (Cohen, MacWhinney, Flatt and Jeferson 1999), Cypriot Greek (Arvaniti and Tserdanelis 2000, Tserdanelis and Arvaniti 2001). Al-Tamimi (2004) posits that "Greater muscular tension in the articulating organs" is mandatory to produce geminates (Trubetzkoy 1969:161). (Catford 1977:298) postulates that geminates requires to "hold the articulators and maintain a longer occlusion time for the geminate contoid".

Hassan 1981; Al-Tamimi (2004) argue that there is myodynamic, aerodynamic and acoustic evidence as well as a temporal compensation relationship between geminates and vowels preceding them as cited in Rembarrnga, Mckay's 1980. Other researchers discuss the relationship between geminates and morphological derivation. (Lahrouchi 2010; Dell and Elmedloui 2010)

Referring to one specific language i.e. discussing the issue on the phonological level, it typically refers to the prolongation of consonants. This definition does not mention whether gemination work in syllable boundaries, morpheme boundaries, or word boundaries. Crystal, D. (1989:33) defines gemination as a "sequence of identical adjacent segments of a sound in a single morpheme". Nevertheless, this definition is vague as it does not explain the distribution of gemination across morpheme boundaries or word boundaries. Trask, (1996:154) defines gemination as a "sequence of two identical segments, especially consonants". Again this definition is vague as there is an overlap and mixture between consonants as geminates and lengthening of vowels. Moreover, it does not explain where the gemination takes place.

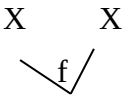
Delattre (1971) views gemination in terms of syllable boundaries. He postulates that there is a re-articulation of consonant: whereas the first consonant represents a coda of the first syllable, the second one represents the onset of the subsequent syllable. He argues that there is a difference between geminates and long consonants in that the articulation of geminates have two phases. Consequently, a geminated /f/, for example, has the representation in (1):

(1) Representations of geminates



According to the above representation, a geminate can be taken as a cluster of the same consonant. The first consonant represents the coda of the first syllable and the second consonant represents the onset of the following syllable. However, long consonants are considered as a single segment with two timing slots as represented in (2

(2) Representation of long consonants



Following Delattre's analysis, Miller (1987) carries out an acoustic study on tautomorphemic and heteromorphemic geminates in Levantine Arabic. Tautomorphemic geminates are consonants that belong to a single morpheme. They might also be called as monosegmental geminates. Heteromorphemic geminates, in contrast, belong to two juxtaposed morphemes and result from a range of phonological processes in language, such as assimilation of consonants or vowel deletion (3-4).

Tautomorphemic geminates in TD

(3) a. sallam '(he) surrendered'
b. kallam '(he) talked'

(4) Coronal

ʔal- daar ⟶ ʔaddaar 'the house'

Miller comes to a conclusion that there seem to be "release spikes" in both geminate types, proposing the availability of movement during the geminate duration. The release spikes spot the point at which the sound is being rearticulated.

Ladefoged (1971) takes a different look at geminates. He regards geminates as long consonants. According to Ladefoged, geminates are better represented by autosegmental representation in (2) above but not that in (1).

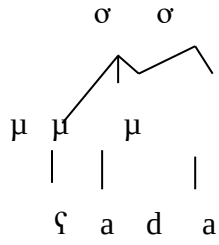
McCarthy (1979) and Leben (1980), adopt an autosegmental method to geminate;, a geminate is considered as a single consonant mapped onto two skeletal tiers as discussed above. Both Ladefoged and McCarthy thus consider

a geminate as a single segment whereas Delattre posits that a geminate should be taken as two indistinguishable segments.

Mitchell (1993) revises the sources of initial geminates in vernacular Arabic and comes to the conclusion that, “an anaptyctic vowel may be heard in most cases of initial gemination but it is never essential and better omitted” (pp. 93,94). However, this claim is not supported by evidence as initial gemination is available without any vowel epenthesis.

As for Moraic Theory, a geminate is viewed as a consonant encoding intrinsic weight more than length. It postulates that a geminate is at all times moraic, and any CVC syllable should be taken as heavy if the coda consonant is part of an underlying geminate, even in languages where CVC syllables otherwise count as light (Tranel (1990)). Thus, a word like /ʕad*da/ meaning (he counted) in Arabic will have the syllable structure in (5) under Moraic Theory:

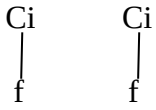
(5) Geminates within Moraic Theory



The most extraordinary feature of geminates is the one discussed in Kenstowicz and Pyle (1973). They posit that geminates form a link that does not adhere to phonological rules in two aspects: first, geminates never form a phonological rule that has an impact of the first half of the geminate without the second half of the geminate; on the other hand, geminate clusters do not allow vowel epenthesis to separate them into two parts. These two phonological features are known respectively as *inalterability* as well as *inseparability*.

Within linear phonology, geminates are differentiated from singletons by the feature [+long]; alternatively, they are known to as a sequence of two similar segments (6)

(6) Representation of the Geminate /ff/ in Linear Phonology:



Thurgood (1993:1) states that "syntagmatically, the most favored environment for long consonants to occur in is intervocalically, following a short, stressed vowel and preceding another short vowel." Thus, cross-linguistically, geminates have a tendency to occur in the intervocalic phonetic environments and following short stressed vowels (Thurgood 1993). Consequently, most of the suggested phonological representations of gemination are "almost exclusively from intervocalic geminates; it is perhaps unsurprising that they should face some difficulties in representing non-intervocalic geminates" (Muller 2001:12).

Geminates in the medial position in Arabic are contrastive. Nevertheless, the distinctive feature of geminate/singleton in the final position contrast in Arabic is debatable. Mitchell (1990) lists the two Arabic words /ʕaam/ (year) and /ʕaamm/ (public) to exemplify distinctiveness (as cited in Abu-Abbas, Khaled, H (2011). El Saaran (1951) provides a list of examples that show distinctiveness of geminate/singleton in word-final position. Some of the examples are (/ħaad/ (deviated) and /ħaadd/ (sharp). On the other hand, Cowell (1964:23) states that, in Syrian Arabic, word final geminates "may occur after an accented vowel"; however, they "do not actually contrast with single ones." Like Cowell, Ghalib (1984: 31) contends that "geminates occurring word-finally are non-distinctive in Arabic because contrasts between single and geminate consonants in this position are non-significant."

As regard to temporal duration between geminate/singleton consonants, most of works on gemination in Arabic conclude that geminates intervocalically represent temporal differences with the preceding vowel (Blanc 1952; Mitchell 1990; Al-Tamimi 2004;) etc.

Al-Tamimi, Abu-Abbas, & Tarawneh (2010) provide convincing proof as regard the contras of geminates in final position in Arabic. Using spectrographic and videofluoroscopic analyses demonstrate that final geminates are allowable in Jordanian Arabic. As a matter of fact, it is possible in all different varieties of the Arabic dialects. The compensation in duration of the preceding vowel and the tension in articulating the geminates increase the perception of boundaries and maintain phonemic differences.

Gemination as described in this paper is a phonetic feature regardless of the phonological or grammatical constraints of the word. If the word is prolonged during speech, it is considered as geminate. 'Thashdeed', a term used in TD for gemination, is not simply the lenghthening of consonants; it may be defined as "consonants pronounced longer in duration than their single counterparts and with great tenseness of articulation" (Mitchell, 1975:xiv). In TD, gemination

may occur either a) within the morpheme boundaries, b) syllable boundaries or c) at the word boundaries. For examples of the three sets consider the following data:

(7) (a) morpheme boundaries (monomorphemic words)

/ʕann/	appeared
/ʔann/	moan
/zann/	complained
/ʕadd/	counted
/kadd/	overworked

(b) syllable boundaries

/χabba:z/	baker
/kaðða:b/	liar
/zamma:r/	singer
/χarra:tˁ/	bluffer
/laʕʕa:b/	player
/namma:m/	gossip

(c) Word boundaries

/ʔɪn naðhab/	if we go
/ʔɪð ðahba/	when he went

Some phoneticians argue that it is because of the syllable division, a geminate sequence cannot be regarded as simply a long consonant, and they claim that the transcription differences usually indicate this, e.g.[ff-] is geminate, [f:] is long" Crystal (1989:33). Catford indicates that "geminates or geminate sequences as, say. [zz], involves continuity of articulation – a prolongation of the articulatory posture – and might thus be termed a 'long' consonant than rather a geminate sequence of two segments". Catford, (1977:210).

However, a segment can be prolonged without being geminated. For example, [f] can be prolonged for five seconds or more and no gemination takes place. The term 'tashdeed' in TD, which is close in meaning to the English term 'gemination' means that the articulatory organ is firmly contacted with the passive organ that the sound produced is received differently from a merely long consonant. Thus, prolongation of a segment and 'tashdeed' are distinctly different.

Hence, gemination is a phonetic process that occurs in TD and applied to those cases where the sequence occurs within the same morpheme or within the same syllable. Gemination also occurs in the sequence of two syllables or two words. Whenever the term gemination is used in this paper in respect of TD, it is used in the sense of 'tashdeed'.

Gemination process is added to the single consonant to accomplish one of the following functions: (a) strengthen the effect of meaning (stronger word), (b) to create a causative meaning, and (c) for phonemic contrast. e.g. (8)

(8) (a) /qatala/killed

/qattala/ killed severely or massacred

(b)	/ɡalasa/	sat down
	/ɡallasa/	made him sit down
	/kaðaba/	lied
	/kaððaba/	accused him of lying
(c)	/saarr/	pleasing
	/saar/	walked away
	/ʔann/	moaned
	/ʔan/	that

The general framework of gemination in TD is either to make an intransitive verb transitive, or to indicate an exaggeration or frequency of an event etc. There is no gemination at the end of the word unless it is a monosyllabic word. Disyllabic words and more are not amenable to geminate at the end of the word. Rather, the gemination takes place in the middle of the word creating a syllable division.

1.2 The Present Study

This study on gemination in Ta'zi Dialect is based on a spectrographic analysis to achieve the following *aims*:

1) to find out the difference in length between the geminated and non-geminated segments.
2) to find out if there is any influence of the consonant on the length of the preceding and the following vowels.
3) to find out if there is any pattern according to the manner of articulation.
4) does the secondary articulation affect the length of the geminated words in case of gutturals?
5) which segment takes more time and why?
6) is there any difference as to duration between voiced and voiceless geminates?

This study contributes to the literature on gemination by providing a detailed examination of Ta'zi Dialect (TD). There are few phonetic studies of TD, and none on the acoustic patterns of consonant length in the colloquial variety. While consonant gemination in TD is very frequent and plays an important morpho-syntactic role in the language, little is known about the phonetic realization of singleton and geminate targets in this dialect.

1.3 The Status of Geminates

There are several ways in which quantity (with reference to vowels and consonants) may be linguistically analysed. One of the problems regarding segmental quantity is whether all the long and short vowels and/or consonants should be listed in the phonemic inventory of the language. "This doubles the number of units in the inventory, and if indeed the system is symmetrical, it would be more economical to extract length from the system and treat it as a prosodeme". Lehiste, (1970:43)

Linguists often argue whether the geminate clusters are to be treated as new phonemes or like any other consonantal cluster. According to Haugen, (1949:281-2), " as soon as sound extends beyond the boundary of a syllable, it is uniformally interpreted as a new phoneme. The long 't' of Italian 'fatto' is regarded as two 't's even though there is no actual break between them. A long vowel within which there is a syllable boundary is universally held to be two".

Lehiste proposes that "if a language has consonant clusters that function in the same manner as long consonants, it may be useful to analyse these long consonants as clusters of identical consonants regardless of whether it is possible to demonstrate phonetically their geminate nature" Lehiste, (1970:43-45).

It has been customarily agreed upon among phonologists that gemination takes place only when preceded by short vowels. But the following data from TD shows that gemination takes place in free variation whether preceded by short or long vowels or followed by short or long vowels.

(9) (a) with short vowels

/kassara/	smashed
/qattala/	slaughtered
/laqqata/	picked up

(b) with long vowels

/ ma:rr/	pedestrian
/fa:rr/	escaper
/ðɑ:rr/	harmful

(c) across morpheme boundaries

/ðɑ:nnu:n/	thinkers
/ma:nnu:n/	naggers
/marru:n/	pedestrians

1.4 Gemination in English

In English, long syllabic consonants occur within the phrase at the juncture of two words, (e.g., shot tigers), or of a word and certain morpheme boundary, e.g., (unknown), (saneness) but never with the word proper.

Thus, one of the main difficulties encountered by the English-speaking students learning TD is closely related to their patterns of stress and rhythm. "Students tend to pronounce TD with stress-timed i.e. they use a heavy stress on most of the syllables in sentences which had word-stress, particularly with those syllables containing a long vowel or ending with geminate consonants, and tend to weaken the stress of the other syllables. In those weak-stress syllables the students tend to shorten the vowel and obscure its quantity". Kennedy, (1960:32). For example, the phrase /kabbajt azzajt/ (you poured the oil) might not be understood if the /bb/ and /zz/ are not geminated.

The observation by Kennedy is partly true. Stress in TD is predictable and does not play a major role in changing the meaning. What is more important is that the non-Arab students who are learning TD do not pronounce the "tashdeed" properly. They find it difficult to make the two articulators tightly pressed against each other for a considerably prolonged time. In other words, if the segment is prolonged properly, the gemination takes place correctly, and the stress pattern will be automatically placed on the correct syllable. Thus, failing to geminate results in a wrong stress. For example, the word /ħamma:m/ (toilet) might be taken as /ħama:m/ (pigeons) if the first /m/ is not geminated properly. Long consonants in the intervocalic position

contain a syllabic boundary and are distributed between the two syllables so that the first part of the consonant closes the preceding syllables and the second part starts the following syllable. In TD, voiceless and voiced stops, nasals, laterals, fricatives, approximants, pharyngeals and the glottal stop all without exception can occur in the geminated form.

Lehiste (1970) indicates that certain problems arise in determining whether a length difference is distinctive when a difference in vowel length is accompanied by an equally noticeable quality difference, it is often true that a listener responds to either the quantity difference or the quality difference, disregarding the concomitant phonetic cues as allophonic. "The native speaker's reaction may in such cases provide a suggestion as to which of the two – duration or phonetic quality – is of primary importance". Lehiste, (1970:30).

Lehiste (1970) indicates that there are some languages in which the quantity of a given segment is related to the quantity of other segments in the sequence. In TD, generally speaking, there exists an inverse relationship between the quantity of a vowel and that of the following consonant, so that a short vowel is followed by a long consonant and a long vowel by a short consonant. However, there are some examples where a long vowel is followed by a long consonant and a short vowel is followed by a short consonant.

Furthermore, in TD two long syllables may follow each other; a long consonant may be preceded by a long vowel and followed by a long vowel as well. In TD, length of vowels and consonants is phonemic and contrastive. This opens an option to consider this extra length as allophonic.

(10)	/taʕba:n/	sick
	/taʕba::n/	very sick
	/tˁɑjjib/	nice
	/tˁɑjj:ib/	very nice
	/zaʕla:n/	upset
	/zaʕla::n/	very upset
	/kabi:r/	big
	/kabi::r/	very big

Assimilation can also cause gemination in TD. When sequences of homorganic but not identical clusters are neighbours in word boundaries, the result will be one single geminated consonant. For example, when /n/ occurs at word final position and followed by frictionless continuant in the next adjacent word /r/, resulting with /rr/ double consonant. Thus,

[n] ----- [rr] ----- [r] # e.g. [man rabbak] → [marrabbak] (who's your lord?)

This rule reads /n/ → [rr] / /n/ _____ /r/.

Similar phonological process is applicable with the following consequences: Examples:

[n] → [ll] / /n/ _____ /l/. [man lak] → [mallak] (who's for you?)

[n] → [jj] / /n/ _____ /j/. [man jaʕmal] → [majjaʕmal] (who works)

Gemination in TD is often impacted by the surrounding vowels, particularly the preceding vowel. Generally speaking, the geminate consonant has an impact on the quantity of

the preceding vowels. In other words, the vowels preceding the geminate consonants in monosyllabic words are almost always short: e.g.,

(11)	/tamm/	finished
	/ta:m/	complete
	/ʕamm/	spread
	/ʕaamm/	passed the night
	/qall/	became scarce
	/qa:l/	said

Degemination of consonants is compensated by the lengthening of the vowels.

Another point Catford (1977:211) mentions is about the 'geminate' semivowels [-ww-] and [-jj-], which occurs in Arabic in such words as [awwal]. 'first', 'tˤajjib', 'good'. He defines semi-vowels as essentially momentary and 'prolongable'. Thus according to Catford, 'geminate semivowel' is a contradiction in terms".

The tendency to describe semivowels as momentary grew out from the fact that Catford wants to reject Pike's (1943) term 'contoid' and vocoid' and thus he describes [w]and [j] in Arabic as momentary. The Arabic [w] and [j] can be prolonged as any other consonant for a considerable amount of time. They do not tend to glide to [u] or [ɪ] as in English. However, the most prominent feature of these geminate semivowels is "their rapid on-and-off- glide and it is this which preserves their semi-vocalic character", Catford (1977:211). This claim has been instrumentally proved. The semivowels are shorter when geminated than most of other consonants. (See table 1.5).

1.2 The Present Study

This study on gemination in Ta'zi Dialect is based on a spectrographic analysis to achieve the following *aims*:

7) to find out the difference in length between the geminated and non-geminated segments.
8) to find out if there is any influence of the consonant on the length of the preceding and the following vowels.
9) to find out if there is any pattern according to the manner of articulation.
10) does the secondary articulation affect the length of the geminated words in case of gutturals?
11) which segment takes more time and why?
12) is there any difference as to duration between voiced and voiceless geminates?

This study contributes to the literature on gemination by providing a detailed examination of Ta'zi Dialect (TD). There are few phonetic studies of TD, and none on the acoustic patterns of consonant length in the colloquial variety. While consonant gemination in TD is very frequent and plays an important morpho-syntactic role in the language, little is known about the phonetic realization of singleton and geminate targets in this dialect.

1.5 Procedure

More than fifty words comprising minimal words are collected from the TD (see table 1.4) to find out the difference in length between the geminated and the non-geminated consonants in words and the consequences of this process.

The pairs have been collected carefully so as to represent different manners of articulation. Then the words, which have test sounds in the medial positions, have been mixed up and ordered arbitrarily so that no subconscious stress should be given to the geminated words. To avoid confusion between the pairs, a similar number was given to each pair in the list. With special care and preparation, the words are uttered by the researcher into the program and the spectrograms are obtained.

1.5.1 Consonant phonemes in TD

TD has slightly different phonemes from the Standard Arabic (SA) and from the phonemes of other Yemeni dialects such as the Sana'ni Dialect (SD). The following table compares the phonemes of the TD to SA and to SD.

Table 1.1 ***Consonant phonemes of TD compared to SA and SD***

No	TD	Description	SA counterparts	SD counterparts
1	b	voiced bilabial plosive	b	b
2	t	voiceless denti-alveolar plosive	t	t
3	tˤ	voiceless pharyngealized denti-alveolar plosive	tˤ	tˤ
4	d	voiced denti-alveolar plosive	d	d
5	k	voiceless velar plosive	k	k
6	g	voiceless velar plosive	ʤ	ʤ
7	q	voiceless uvular plosive	q	g
8	ʔ	voiceless glottal stop	ʔ	ʔ
9	-	/đ/ replaced by /ðˤ/ in TD and SD.	đ	-
10	m	voiced bilabial nasal	m	m
11	n	voiced denti-alveolar nasal	n	n
12	f	voiceless labiodental fricative	f	f
13	θ	voiceless dental fricative	θ	θ
14	ð	voiced dental fricative	ð	ð
15	ðˤ	voiced pharyngealized dental fricative	ðˤ	ðˤ
16	s	voiceless alveolar fricative	s	s
17	sˤ	voiceless pharyngealized alveolar fricative	sˤ	sˤ
18	z	voiced alveolar fricative	z	z
19	ʃ	voiceless postalveolar fricative	ʃ	ʃ
20	χ	voiceless uvular fricative	χ	χ
21	ʁ	voiced uvular fricative	ʁ	ʁ
22	ħ	voiceless pharyngeal fricative	ħ	ħ
23	ʕ	voiced pharyngeal fricative	ʕ	ʕ
24	h	voiceless glottal fricative	h	h
25	r	voiced alveolar trill	r	r
26	l	voiced alveolar lateral	l	l
27	j	voiced palatal approximant	j	j
28	w	voiced labio-velar approximant	w	w

Table 1.1 shows that TD contains 27 consonant phonemes compared to 28 in SA. The phoneme /đ/ in SA is replaced by /ðˤ/ in TD. The phoneme /ʤ/ in SA is replaced by /g/ in TD. Other phonemes in TD are symmetrical to the phonemes of SA in the phonemic as well as in the phonetic representations.

1.6 Duration of Sounds in Medial Position

1.6.1 Stops

Under each phoneme given below, the comparative length of the consonants single/geminated in milliseconds and the ratio is highlighted.

/ʔ/

ʔ: ʔʔ= 35:175 R= 1:5

raʔasa 615 msec	duration	raʔʔasa 735 msec	duration
r	125	r	170
a	130	a	110
ʔ	35	ʔʔ	175
a	120	a	85
s	65	s	55
a	140	a	140

There is, due to gemination, the duration of the preceding and the following vowels is reduced. The initial consonant of the geminated word is lengthened due to the trilling given to /r/ as a launching preparation to utter the geminate properly.

/ q /

q: qq= 90:230 R= 1:2.5

baqara 575 msec	duration	baqqara 715msec	duration
b	80	b	120
a	110	a	80
q	90	qq	230
a	120	a	115
r	15	r	20
a	160	a	150

It is clear that the geminated voiceless uvular plosive has more length than its non-geminated counterpart. The initial consonant in the geminated word has more duration than the initial consonant in the non-geminated word. The preceding and the following vowels have less duration than their counterparts in the non-geminated word.

/ g /

g: g g= 55:170 R= 1:3

ʃagar 475 msec	duration	ʃaggar 600 msec	duration
ʃ	130	ʃ	190
a	130	a	100
g	55	gg	170
a	130	a	120
r	30	r	20

From the data above, it is clear that the duration of the initial consonant is affected by gemination. The preceding as well as the following vowels of the geminate are also affected.

/ k /

k: k k= 95:220 R= 1:2.3

sakan 640 msec	duration	sakkan 755msec	duration
s	110	s	150
a	115	a	110
k	95	kk	220
a	150	a	110
n	170	n	165

/d/

d: dd= 70:210 R= 1:3

badal 640 msec	duration	baddal 780 msec	duration
b	150	b	180
a	120	a	110
d	70	dd	210
a	150	a	130
l	150	l	150

/t/

t: tt= 70:210 R= 1:3

matar 550 msec	duration	mattar 650msec	duration
m	60	m	150
a	120	a	110
t	70	tt	210
a	150	a	130
r	150	r	150

/tˁ/

tˁ: tˁtˁ= 110:210 R= 1:2.1

matˁar 580 msec	Duration	matˁtˁar 740 msec	duration
m	60	m	150
a	110	a	100
tˁ	110	tˁ tˁ	210
a	150	a	130
r	150	r	150

Pharyngealised /tˁ/ shows its influence when geminated not only on the consonant concerned (when compared to /t/), but also on the duration of the neighbouring vowels. Due to gemination, the vowels following and preceding the pharyngealized phonemes are comparatively short.

/b/

b:bb= 60:170 R= 1:2.8

sabaq 460 msec	duration	sabbaq 550 msec	duration
s	130	s	150
a	100	a	70
b	60	bb	170
a	150	a	140
q	20	q	20

1.6.2 Nasals

/m/

m:mm= 80:240 R= 1:3

samar 630 msec	duration	sammar 720 msec	duration
s	160	s	210
a	120	a	75
m	80	mm	240
a	160	a	95
r	110	r	100

/n/

n:nn= 60:180 R= 1:3

hana 340 msec	duration	hanna 500 msec	duration
h	30	h	130
a	100	a	50
n	60	nn	180
a	150	a	140

Table 1.2 ***Duration of geminated and non-geminated plosives and nasals with duration of preceding and following vowels.***

phoneme	Non-geminate	Preceding vowel	Following vowel	geminate	Preceding vowel	Following vowel
ʔ	35	130	120	175	110	85
q	90	110	120	230	80	115
g	55	130	130	170	100	120
k	95	115	150	220	110	110
d	70	120	150	210	110	130
t	70	120	150	210	110	130
tˁ	110	110	150	210	100	130
b	60	100	150	170	70	140
m	80	120	160	240	75	95
n	60	100	150	180	50	140

Generally, there is a pattern as to the duration of the preceding vowels of the geminates and non-geminates. Moreover, vowels following the geminates tend to be shorter than the vowels following the non-geminates. (see table 1.2).

It is also obvious that the non-geminated pharyngealized /tˁ/ has the highest duration due to the secondary articulation. The vowel following the geminated and the non-geminated pharyngealized /tˁ/ has the highest duration. The geminated /m/ has the highest duration among all stops due to the nasalization and bilabialization at the same time.

Generally speaking, voiceless stops tend to be longer in duration than the voiced stops. If the nasals, and the glottal stop are excluded, the length of the geminates in descending order is as follows:

q = 230, k = 220, t = 210, d = 210, g = 170, b = 170.

1.6.3 Fricatives

/f/

f:ff= 100:150 R= 1:1.5

nafar 430 msec	duration	naffar 450 msec	duration
n	50	n	60
a	60	a	50
f	100	ff	150
a	150	a	120
r	70	r	70

/θ/

θ: θθ= 60:240 R= 1:1.4

ʔaθar 540 msec	duration	ʔaθθar 680 msec	duration
n	110	n	120
a	120	a	100

θ	60	θθ	240
a	120	a	100
r	130	r	120

/ð/

ð: ð ð= 70:210 R= 1:3

baðar 550 msec	duration	baððar 700 msec	duration
b	50	b	160
a	135	a	80
ð	70	ð ð	210
a	175	a	135
r	120	r	115

/ðˤ/

ðˤ: ðˤ ðˤ= 50:180 R= 1:3.6

naðˤar 460 msec	duration	naðˤðˤar 620 msec	duration
n	90	n	130
a	120	a	100
ðˤ	50	ðˤðˤ	180
a	150	a	120
r	50	r	90

/s/

s: ss= 130:230 R= 1:1.8

masak 440 msec	duration	massak 530 msec	duration
m	80	m	90
a	100	a	100
s	130	ss	230
a	110	a	90
k	20	k	20

/sˤ/

sˤ: sˤsˤ= 120:250 R= 1:2.1

masˤar 490 msec	duration	masˤsˤar 590 msec	duration
m	60	m	70
a	110	a	100
sˤ	120	sˤsˤ	250
a	110	a	100
r	90	k	70

/z/

z: zz= 80:200 R= 1:2.5

mazaq 530 msec	duration	Mazzaq 680 msec	duration
m	60	m	90
a	100	a	90
z	80	zz	200
a	110	a	100
q	180	k	200

/ʃ/

ʃ: ʃʃ= 160:300 R= 1:1.9

maʃa 680 msec	duration	maʃʃa 740 msec	duration
m	90	m	140
a	100	a	80
ʃ	160	ʃʃ	300
a	330	a	220

/χ/

χ: χχ= 140:220R= 1:1.6

ʃaχar/ 560 msec	duration	ʃaχχar 600 msec	duration
ʃ	140	ʃ	120
a	100	a	90
χ	140	χχ	220
a	130	a	120
r	50	r	50

/ʁ/

ʁ: ʁʁ= 100:210 R= 1:1.2

ʃaʁal 620 msec	duration	ʃaʁʁal 680 msec	duration
ʃ	120	ʃ	140
a	100	a	90
ʁ	100	ʁʁ	210
a	140	a	90
l	160	l	130

/ħ/

ħ: ħħ= 110:280 R= 1:2.5

kaħal 460 msec	duration	kaħħal 640 msec	duration
k	70	k	130
a	120	a	100
ħ	110	ħħ	280
a	140	a	100
l	20	l	30

/ʕ/
ʕ:ʕʕ= 70:190 R= 1:2.7

saʕal 560 msec	Duration	saʕʕal 660 msec	duration
s	110	s	120
a	100	a	90
ʕ	70	ʕʕ	190
a	130	a	100
l	150	l	160

/h/
h: hh= 80:200 R= 1:2.5

sahar 510 msec	Duration	sahhar 650 msec	duration
s	120	s	180
a	100	a	90
h	80	hh	200
a	110	a	90
r	100	r	90

The table 1.3 shows that the duration of geminated fricatives is more than twice as much as non-geminated fricatives. Generally speaking, gemination has an impact of the preceding and following vowels; all the vowels that precede or follow the geminates are generally shortened.

Table 1.3 ***Duration of geminated and non-geminated plosives and nasals with duration of preceding and following vowels***

phoneme	Non-geminate	Preceding vowel	Following vowel	geminate	Preceding vowel	Following vowel
f	100	60	150	150	50	120
θ	60	120	120	240	100	100
ð	70	135	175	210	80	135
ðˤ	50	120	150	180	100	120
s	130	100	110	230	100	90
sˤ	120	110	110	250	110	100
z	80	100	110	200	90	100
ʃ	160	100	330	300	80	220
χ	140	100	130	220	90	120
ʁ	100	100	140	210	90	90
ħ	110	120	140	280	100	100
ʕ	70	110	130	190	90	100
h	80	100	110	200	90	90

Table 1.4 shows the difference in duration between the voiced and the voiceless fricatives. Voiceless fricatives tend to be longer than their voiced counterparts.

Table 1.4 ***Duration of voiced and voiceless fricatives***

Voiced	Duration	Voiceless	Duration
zz	200	ss	230
ʕʕ	190	ħħ	280
ðð	210	θθ	240
ʁʁ	210	χχ	220

1.6.4 Trills

/r/

r:rr= 20:200 R= 1:10

ʔaraq 470 msec	duration	ʔarraq 570 msec	duration
ʔ	20	ʔ	20
a	150	a	110
r	20	rr	200
a	190	a	150
q	90	q	90

1.6.5 Laterals

/l/

l:ll= 100:270 R= 1:2.7

ʔalam 510 msec	duration	ʔallam 640 msec	duration
ʔ	20	ʔ	30
a	120	a	100
l	100	ll	270
a	120	a	100
m	150	m	140

1.6.6 Approximants (semivowels)

/w/

w:ww= 150:230 R= 1:1.5

ħawal 520 msec	duration	ħawwal 590 msec	duration
ħ	20	ħ	30
a	130	a	120
w	150	ww	230
a	100	a	60
l	120	l	150

/j/

j:jj= 40:220 R= 1:6

χaja:l 610 msec	duration	Xajja:l 690 msec	duration
m	100	m	150
a	100	a	90
j	140	jj	220
a	150	a	130
l	120	l	100

1.7 Results

Table 1.5 summarizes the findings of the spectrographic analysis of the temporal duration of the consonants in TD. The table includes the minimal pairs, their gloss, sound duration and word total duration along with ratio of word duration as well as the geminate versus non-geminate sounds.

Table 1.5 ***Duration of geminated and non-geminated consonants and nasals with total gemination of each word of the pattern along with the ratio***

word	gloss	sound duration	word duration	Ratio of word duration	Gem:non-gem
raʔasa raʔʔasa	presided made him head	35 msec 175 msec	615 msec 735 msec	1:1.9	1:5
baqar baqqar	cows married a cow-like lady	90 msec 230 msec	575 msec 715 msec	1:1.3	1:2.5
ʃagar ʃaggar	trees planted trees	55 msec 170 msec	475 msec 600 msec	1:1.26	1:3
sakan sakkan	lived made him live	95 msec 220 msec	640 msec 755 msec	1:1.17	1:2.3
badal baddal	in place of changed clothes	70 msec 210 msec	640 msec 780msec	1:1.2	1:3
matar mattar	measured measured perfectly	70 msec 210 msec	550 msec 650 msec	1:1.18	1:3
matˁar matˁ tˁar	rain rained heavily	100 msec 210 msec	580 msec 740 msec	1:1.27	1:2.1
sabaq sabbaq	surpassed initiated	60 msec 170 msec	460 msec 550 msec	1:1.19	1:2.8
samar sammar	stayed up nailed	80 msec 240 msec	630 msec 720 msec	1:1.14	1:3
hana hanna	pleasure wished pleasure	60 msec 180 msec	340 msec 500 msec	1:1.15	1:3
nafar naffar	bunch of people annoyed	100 msec 150 msec	430 msec 450 msec	1:1.04	1:1.5

ʔaθar ʔaθθar	trace traced	60 msec 240 msec	540 msec 680 msec	1:1.3	1:4
baðar baððar	sow wasted	70 msec 210 msec	550 msec 700 msec	1:1.3	1:3
naðˤar naðˤðˤar	sight proposed	50 msec 180 msec	460 msec 620 msec	1:1.3	1:3.6
masak massak	caught caught firmly	130 msec 230 msec	440 msec 530 msec	1:1.2	1:1.8
masˤar masˤsˤsar	scarf scarfed	120 msec 250 msec	490 msec 600 msec	1:1.2	1:2.1
mazaq mazzaq	spit tore	80 msec 200 msec	520 msec 680 msec	1:1.3	1:2.5
maʃa maʃʃa	walked drove	160 msec 300 msec	680 msec 740 msec	1:08	1:1.9
ʃaχara ʃaχχra	glared snored	140 msec 220 msec	560 msec 600 msec	1:07	1:1.6
ʃaʁal ʃaʁʁal	tinkered found a job for someone	110 msec 210 msec	620 msec 680 msec	1:09	1:2
kaħal kaħħal	darkened eyes darkened sbd's eyes	100 msec 280 msec	460 msec 640 msec	1:1.4	1:2.5
saʕal saʕʕal	coughed caused sbd to cough	70 msec 190 msec	560 msec 660 msec	1:1.17	1:2.8
sahar sahhar	staying up late caused sbd to stay up late	80 msec 200 msec	520 msec 650 msec	1:1.25	1:2.5
ʔalam ʔallam	pain caused pain	100 msec 270 msec	510 msec 640 msec	1:1.25	1:2.7
ħawal hawwal	squint changed	150 msec 230 msec	520 msec 590 msec	1:1.3	1:1.5
χaja:l χajja:l	Illusion horseman	140 msec 220 msec	610 msec 690 msec	1:1.1	1:1.6

Table 1.5 shows that the duration of geminated consonants is much higher than the non-geminated ones. The geminated trill appears to be the longest compared to the non-geminated trill (1:10), followed by the glottal stop (1:5) and then by /θ/ (1.4), followed by /n/ and the pharyngealized dental /ðˤ/ (1:3.6) and finally /ð, g, d/ and /m/ (1:3). The difference between the other consonants starts from 2.8 for /b/ to 1.5 for /w/ and /f/.

Below is the average of the longest geminated consonants:

Table 1.6 *Longest duration of consonants types.*

Gemination type	Average value
Trill	10.0
Plosives	3.0
Nasals	3.0
laterals	2.7
Gutturals	2.7
Pharyngealized	2.6
Fricatives	2.4
Pharyngeals	1.8
Semivowels	1.8

Table 1.6 shows that the longest consonant is the trill. This is may be attributed to the nature of concomitant trilling for a remarkable time in the Arabic language. When it is geminated, the trilling is definitely increased, and it needs a special attention to control the trilling. Despite the fact that during the pronunciation of the trill in the spectrograph, a great care was taken not to over-trill it, it turns out to be the longest among all other consonants. Trill is followed by the plosives and nasals with an average value of 3.0 each type. Laterals have an average value of 2.7 as well as the gutturals. The term "gutturals" is used in this paper to include only the throat consonants in Arabic i.e. /ʔ, h, ʕ, ħ, ʁ, χ/. Pharyngealized sounds /ðˤ, sˤ, tˤ/, which are sounds that are mainly plosives and fricatives with pharyngealization as a secondary articulation, have an average value of 2.6. It is obvious that the pharyngealized plosive /đ/ is excluded because it is not used in TD. The fricatives have an average value with 2.4 followed by the pharyngeals /χ and ʁ/ and the semivowels with an average value of 1.8 for each type.

1.8 Conclusion:

Consequently, the following inferences can be drawn from the above data:

1. the duration of the geminate consonant in TD is generally twice as much as that of the non-geminates.
2. When geminated, the trill has been found to be the longest among all other consonants, followed by the plosives, and then the nasals, laterals, gutturals, pharyngealized consonants, fricatives, pharyngeals and semivowels. The trill has been found to be the longest due to the repeatedly concomitant trilling of the tongue during the articulation of the sound.
3. The voiceless consonants prove to be longer than their voiced counterparts.
4. It is also observed that the geminated consonants affected the preceding and the following vowels. The adjacent vowels to the geminates are generally shortened.
5. It seems that there is no proof that the secondary articulation affects the length of the geminated words in case of gutturals.

Suggestions for further research

The duration of the sounds may be conditioned by the following factors:

1. The point and manner of articulation of the segment itself,
2. the preceding and following segmental sounds,
3. suprasegmental factors (especially the mora),

4. position of the sound within a higher-level phonological unit

The possible ways of analyses of quantity include:

a) treatment of quantity as a segmental distinctive feature
b) analysis of long sounds as clusters of short sounds, or as a sequence of two (or more) morae)
c) inclusion of short and long sounds as separate entities in the phonemic inventory
d) extraction of quantity as a prosodeme length.

About the Author:

Dr. Nadhim Aldubai is an associate professor of phonetics. He was the Head of the English Department and the vice-dean of the Faculty of Education, Sana'a University. He worked at King Abdul-Aziz University, Jeddah, Saudi Arabia for three years. Currently, he is the Head of the Linguistics Unit at the Department of Foreign Languages at the Faculty of Arts and Humanities, Taibah University. KSA.

References

Abu-Abbas, Khaled, H, Wael M. Zuraiq, & Osama A. Abdel-Ghafer (2011). Geminates and Long Consonants in Jordanian Arabic, *International Journal of Linguistics*, *3*, (1)*:* E14.

Al-Tamimi, Feda (2004). An experimental phonetic study of intervocalic singleton and geminate sonorants in Jordanian Arabic. *Al-Arabiyya*, 29, 37-52.

Al-Tamimi, Feda, Khaled Abu-Abbas and Rama Tarawneh (2010). Jordanian Arabic final geminates: An experimental clinical phonetic study. *Poznań Studies in Contemporary Linguistics* 46:2, 111–125. Poland: Adam Mickiewicz University.

Arvaniti, A. (1999). Effects of speaking rate on the timing of single and geminate sonorants. *In Proceedings of the XIVth International Congress of Phonetic Sciences,* San Francisco, CA, 599-602. Arvaniti, Amalia. and Georgios Tserdanelis. (2000). On the phonetics of geminates: Evidence

Baker, Brett. 1997. Edge crispness: Segment to mora isomorphism. *Proceedings of the West Coast Conference on Formal Linguistics* 16. 33 – 47.

Arvaniti, A. (2001). Comparing the phonetics of single and geminate consonants in Cypriot and Standard Greek. Proceedings of the 4th International Conference on Greek *Linguistics*. Thessaloniki: University Studio Press, 37-44.

Ball, Martin. and Joan. Rahilly. (1999). Phonetics: The science of speech. London: Arnold.

Blanc, Haim. (1952). *Studies in north Palestinian Arabic.* Jerusalem: Central Press.

Catford, John (1977). *Fundamental problems in phonetics*. Edinburgh: Edinburgh university press.

Cowell, Mark. (1964). *A reference grammar of Syrian Arabic*. Washington D. C.: Georgetown University Press.

Crystal, D. (1989). *Dictionary of Linguistics and Phonetics*, (2nd edition), Basil Blackwell.

Delattre, P. (1971). Pharyngeal features in the consonants of Arabic, German, Spanish, French, and American English. *Phonetica,* 23, 129-55.

Dell, F. and Elmedlaoui M. (2010). Syllables and gemination in imperfective stems in Tashlhiyt Berber, ms. *[Online] Available: http://franswadal.objectis.net.downloads/Dell-ElM.*

El Saaran, M (1951). *A critical study of the phonetic observations of the Arab grammarians.* Unpublished Ph.D. Thesis, university of London.

Esposito, Anna & Maria Gabriella di Benedetto. (1999) Acoustical and perceptual study of gemination in Italian stops. *Journal of the Acoustical Society of America*, 106:4, 2051-2062. from Cypriot Greek. *Proceedings of International Conference on Spoken Language Processing* (ICSLP2000), Beijing, 23-27.

Ghalib, G. B. M. (1984). *An Experimental Study of Consonant Gemination in Iraqi Colloquial Arabic*.Unpublished Ph.D. Thesis, University of Leeds.

Hartman, R.R.K. and Stork, F.C. (1972). *Dictionary of Language and Linguistics,* Applied Science Publishers, LTD, London.

Hassan Z. M. (1981). *An Experimental Study of Vowel Duration in Iraqi Spoken Arabic,* Unpublished Ph.D. thesis U.K: Dept. of Linguistics & Phonetics, University of Leeds.

Hassan, Z. M. (2003). Temporal compensation between vowel and consonant in Swedish & Arabic in sequences of *CV:C & CVC: and the word overall duration. PHONUM, 9: 45-48. http://www.ling.umu.se/fonetik2003*

Hassan, Z. M. (2002). Gemination in Swedish & Arabic with a particular reference to the preceding vowel: an instrumental & comparative approach. *In Proceedings of Fonetik TMH-QPSR,* 44: 81-85. Swedish Loredana Cerrato Centre for Speech Technology.

Haugen, E. (1949). Phoneme or Prosodeme, *Language*, 25:278-282.

Haugen, E. (1958). The Phonemics of Modern Icelandic, *Language*, 34:55-98.

Kennedy, N. (1960). *Problems of Americans in Mastering the Pronunciation of Egyptian Arabic,* Washington, Center for Applied Linguistics.

Kenstowicz, M and C. Pyle. (1973). *On the Phonological Integrity of Geminate Clusters.* The Hague.

Kenstowics, M. (1994). *Phonology in generative grammar.* Oxford: Blackwell Publishers

Kenstowicz M and C. Kisseberth, (Eds.), (1973). *Issues in phonological theory,* Mouton: The Hague.

Khattab, G. (2006). *Does child-directed speech really facilitate the emergence of phonological structure? The case of germination in Arabic CDS.* Paper presented at Labphon 10, Paris, July 2006.

Khattab, G. (2007). A Phonetic Study of Gemination in Lebanese Arabic, *.icphs, Saarbrücken,* Germany

Khattab, G. (2007). Lebanese Arabic Speech Acquisition. *In S. McLeod (ed.). The International Guide to Speech Acquisition*. USA: Thomson Delmar Learning.

Ladefoged, P. (1971). *Preliminaries to linguistic phonetics.* Chicago: The University of Chicago Press.

Ladefoged, P. & Maddieson, I. (1996). *The Sounds of the World's Languages.* Wiley, NY

Lahrouchi, Mohamed. (2010). On the internal structure of Tashlhiyt Berber triconsonantal roots. *Linguistic Inquiry* 41, pp. 255-285.

Leben, W. (1980). A metrical analysis of length. *Linguistic Inquiry* 11, 497-509.

Lehiste, Ilse, (1967). *Readings in Acoustics Phonetics,* The MIT Press. Lehiste, Ilse, (1970). *Suprasegmentals,* The MIT Press.

McCarthy, J. (1986). OCP effects: Gemination and antigemination. *Linguistic Inquiry* 17, 237-93.

McCarthy, J. and Alan P. (1990). Foot and word in prosodic morphology: The Arabic broken plural. *Natural language and Linguistic Theory* 8, 209-84.

Mckay, Graham (1980). Medial stop gemination in Rembarrnga: A spectrographic study. McMenamin, Gerald. And Thurgood, Graham, (Eds.), *Papers in honor of Frederick Brengelman on the occasion of the twenty-fifth anniversary of the Department of Linguistics.* Fresno: California State University, 129–139.

Miller, Ann M. (1987). Phonetic characteristics of Levantine Arabic geminates with differing morpheme and syllable structures. *Working Papers in Linguistics* ,Ohio State University,36, 120-41.

Mitchell, T. F. (1975). *Principles of Firthian Linguistics*, Longman.

Mitchell, T. F. (1993). *Pronouncing Arabic 2*. Oxford: Clarendon Press.

Muller, Jennifer. (2001). *The phonology and phonetics of word-initial geminates.* Ph.D. diss., Ohio State University.

Pike, K.L. (1943). *Phonetics*, University of Michigan Press.

Thurgood, Graham. (1993). Geminates: A cross-linguistic examination. In Nevis, Joe, McMenamin, Gerald. and Thurgood, Graham, (Eds.), *Papers in honor of Frederick Brengelman on the occasion of the twenty-fifth anniversary of the Department of Linguistics*. Fresno: California State University, 129–139.

Tranel, B. (1991). CVC Light Syllables, Geminates and Moraic Theory. *Phonology*, 8.291-302.

Trask, R.L. (1996). *A Dictionary of Phonetics and Phonology*, Routledge, London and New York.

Trubetzkoy, Nicolai. (1969). *Principles of phonology*. Los Angeles: University of California.

Tserdanelis, Georgios. & Amalia. Arvaniti (2001). The acoustic characteristics of geminate consonants in Cypriot Greek. *Proceedings of the Fourth International Conference on Greek Linguistics*, pp.29-36. Thessaloniki: University Studio Press.