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THE FEATURES OF /k/ AND /q/ IN CAIRO STANDARD ARABIC

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Introduction

The argument concerning "emphatic consonants" in Arabic is longstanding[1-4]. Most linguists in Semitic language have categorized consonant/q/ as an "emphatic" consonant. Recently A. Giannini and M.Pettorino have defined the consonant/q/ just as a voiceless, uvular stop, but not as an "emphatic" consonant[5]. Apart from the discussion as to whether /q/ in Arabic is "emphatic" consonant or not, the following problems will be discussed in this study.

1. The difference of features in F1 and F2 of vowels connected to /q/ and /k/.
2. The difference between /q/ and "emphatic" consonants in F2 of neighbouring vowels.
3. The effect of /q/ on surroundings in the sequence of phonemes.
4. Comparison of duration between /q/ and /k/.

Procedure and method

Using the minimal pairs containing the consonant /q/ or /k/ and the same carrier sentence already designed[4], the following four sentences were prepared for the experiment.

1) /haʕaka:l/ ("This is 'measure'.")

2) /haʒaqa:l/ ("This is 'say'.")

3) /haʒala:k/ ("This is 'chew'.")

4) /haʒala:q/ ("This is 'be proper'.")

/haʒa/ means "this is" in Arabic.

The words aimed for discussion are as follows;

/ka:l/, /qa:l/, /la:k/, /la:q/

The speech sound used in the experiment was recorded in September of 1982 in the anechoic recording studio of RILP. The informant was a native speaker of the standard Cairo dialect of modern Arabic. The speech sound was analyzed by means of sound spectrograms with a Digital Sona-Graph 7800(KAY Elemetric Corp),

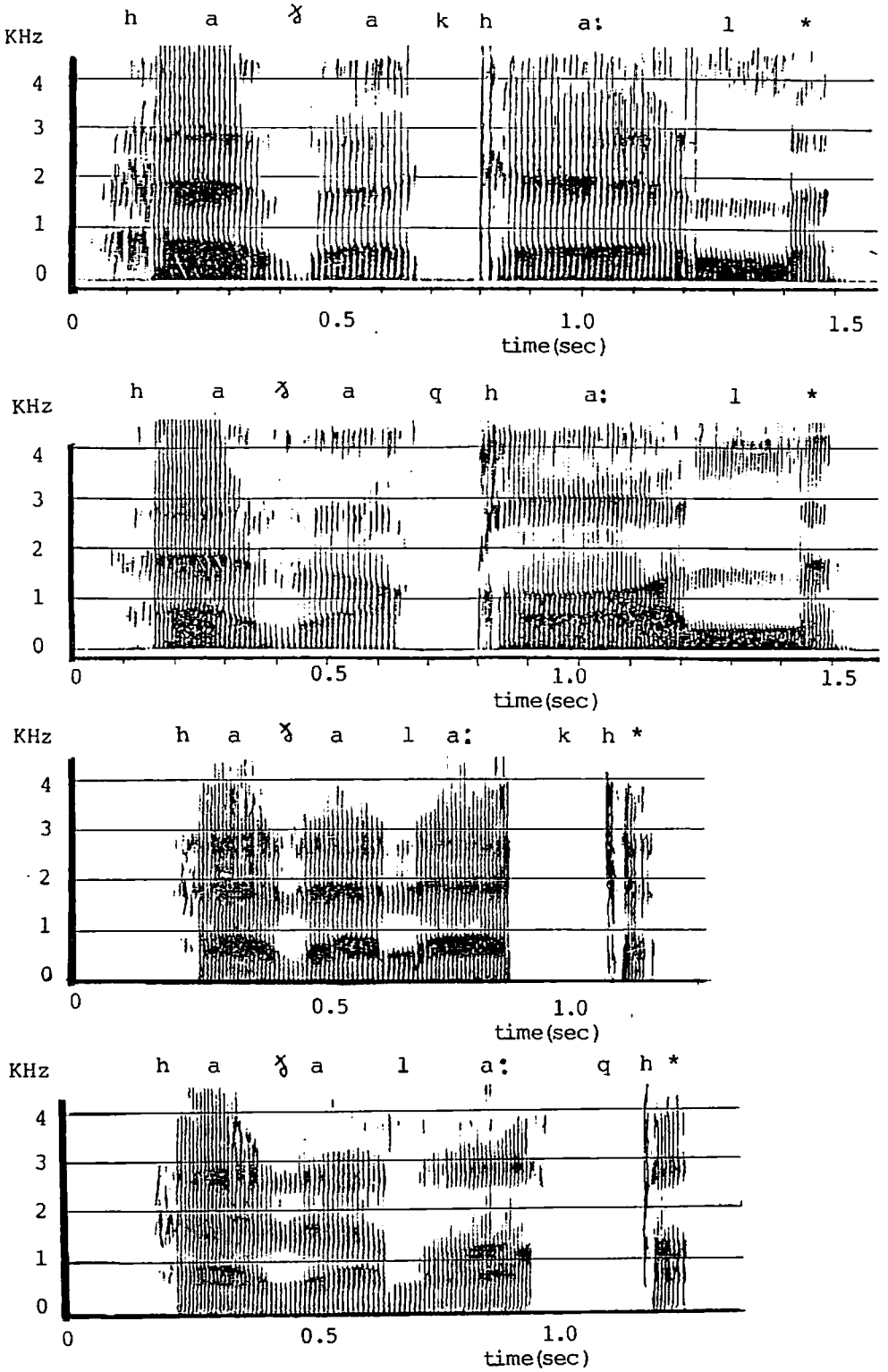

Fig.1 The feature of formants for whole speech of each sentence. The sign "*" shows vowel-like sound[4] also "h" shows frication for convenience.

LPC analysis program6) and SPSS program on the VAX-11/780 system.

Results

1) Formant of /q/ and /k/:

Fig.1 shows comparison of the different features for the four kinds of sentences. It is clear that the formant F1 and F2 of the vowels connected to the both sides of /q/ are effected by /q/. As previous studies have mentioned,the behaviour of F1 rising and F2 falling are characteristic in /q/ compared with /k/. The F2 fall is especially remarkable. In comparison between the figure for /haʒaka:l/ and the one for /haɣaqa:l/ F1 is falling and F2 is rising just before the initiation of stop of /k/, while F1 is rising and F2 is falling in /q/. On the contrary F1 is rising and F2 is falling just after the duration of noise of burst in /k/, while F1 is falling and F2 is not rising but nearly level after the burst of /q/.

2) The difference between /q/ and "emphatic" consonants:

Fig.2 shows the features of the sentences, /haɣasa:d/, /haɣaʂa:d/, /haɣata:b/ and /haɣaʈa:b/ respectively, where /ʂ/ and /ʈ/ are the "emphatic" consonants. The former two sentences and the sentence of /haʒaka:l/ have a similar pattern of formants. On the contrary the latter two sentences have a rather less similar pattern to that of the sentence of /haɣaqa:l/. The emphatic consonants affect even the end of the sentence, while the effect of /q/ reaches to the following vowel and the influence already disappears in the final part of the following vowel. No effect of /q/ is observed in segment/l/ following the vowel, and the vowel-like segment4) of the final part of sentence. As a result it seems that the "emphatic" consonants may have a greater effect on following syllables than that of /q/.

V<-C(emphatic)->V->C->V , V<-C(q)->V

In this study, for convenience, the signs <- and -> show anticipatory and carryover effect, respectively.

This result is not in agreement with that of A.Giannini and M.Pettorino5).

3) Effect of /q/ on the other syllables of sequence in relation to F2 changing:

As observed above, the effect of /q/ on the following phonemes is limited to some extent. As for the anticipatory effect of /q/ in sentence 2 (/haɣaqa:l/), this reaches only to the preceding syllable: C<-V<-C(q)->V.

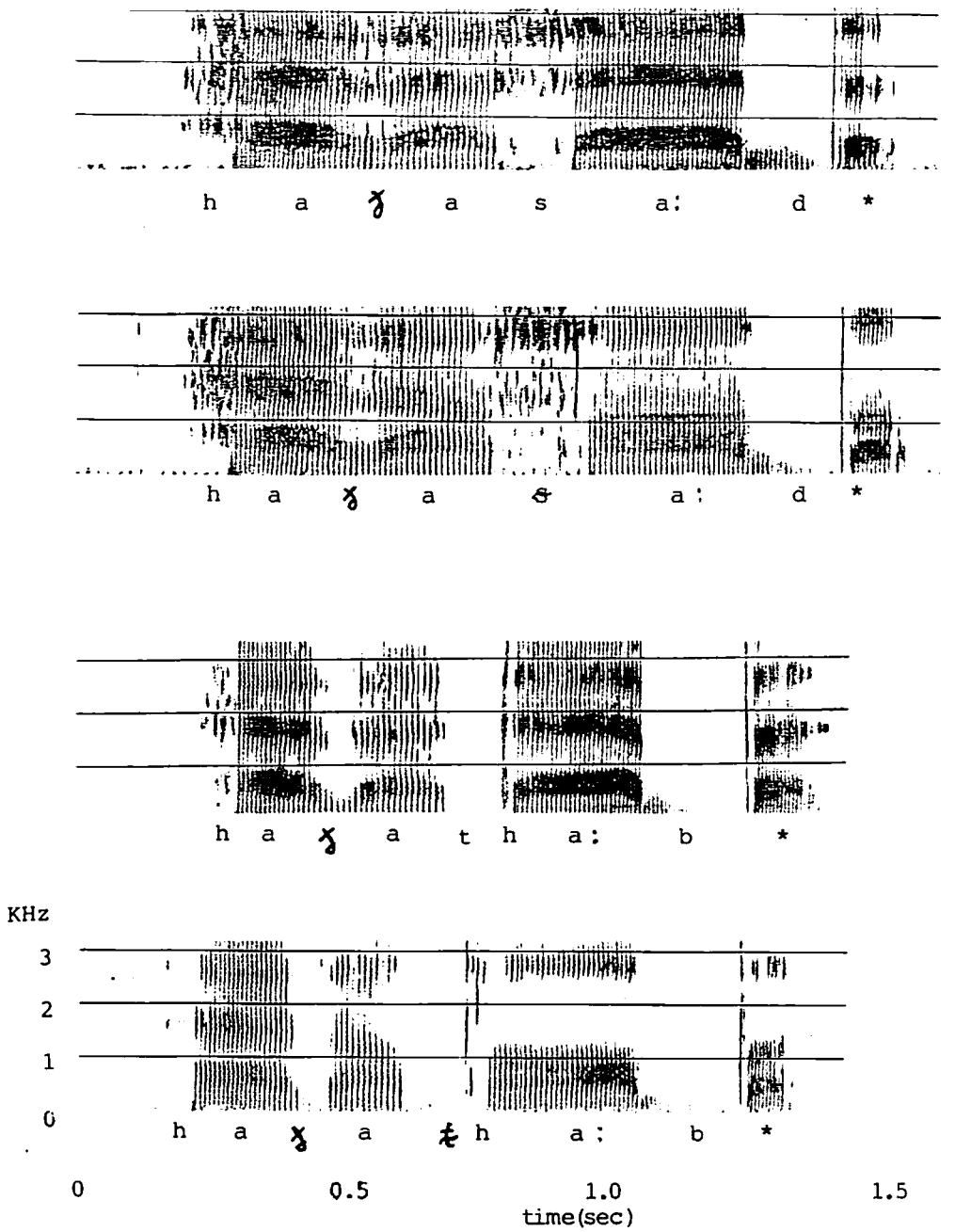

Fig.2 Comparison of formants for the sentences between /haɣasa:d/ and /haɣaɕa:d/ and between /haɣata:b/ and /haɣaɕa:b/.

On the other hand, in sentence 4,namely, /haʔala:q/, the anticipatory effect of /q/ reaches to the second preceding syllable: V<-C<-V<-C(q)->*, here the sign "*" gives a vowel-like syllable[4]).

As a whole there is a difference between the carryover effect and the anticipatory effect in consonant/q/. On the contrary the consonant /k/ has no remarkable effect on the surrounding phonemes in the pattern of F2.

4) Comparison of the duration between /q/ and /k/:

From the wave form of the speech sound for test sentences, it becomes clear that the frication follows the burst of the consonant /q/ and that its duration has a similar value to that of aspiration for the consonant /k/ as follows.

Table 1 Comparison of duration between the frication after the closure of /q/ and the aspiration after the closure of /k/.

Word	Frication	Duration(ms)	Duration in word(%)
ka:l	Aspiration	48.6	6.3
qa:l	h(q)	44.6	5.6
la:k	Aspiration	28.0	4.9
la:q	h(q)	29.1	5.0

When the stops are at the beginning of the word, the duration of frication is longer, while it becomes shorter when they are at the end of the word. Both Fig.3.1 and Fig.3.2 show the pattern of frication after closure of /q/ compared with the aspiration after the closure of /k/. A.Giannini and M.Pettorino described that;

> "according to E.Brucke(1860) the laryngeal closure opens at the same time as the epilaryngeal closure and the glottal vibrations of the following vowel begin at the same time as the release of the closure"[5])

and also they described from the study by G. Panconcelli Calzia[5,7]), as follows;

> "the glottal vibrations of the vowel which follows the <emphatic> consonants t q begin earlier than is the case for the vowels which follow the corresponding <non-emphatic> t k"

Regarding consonant /q/, S. H. al-Ani reported that;

> "This is followed by a silence gap with an average duration of 30-40 msec, with no noise following the spike. This indicates a lack of aspiration"

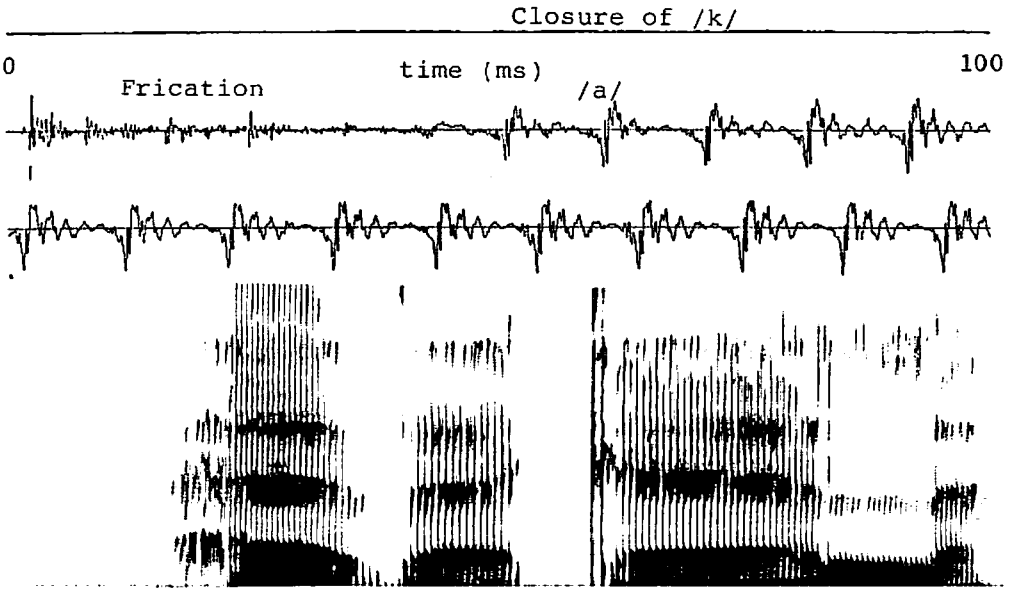

Fig.3.1 Frication following the closure of /k/ for sentence /haχaka:l/ in wave form and sound spectrogram.

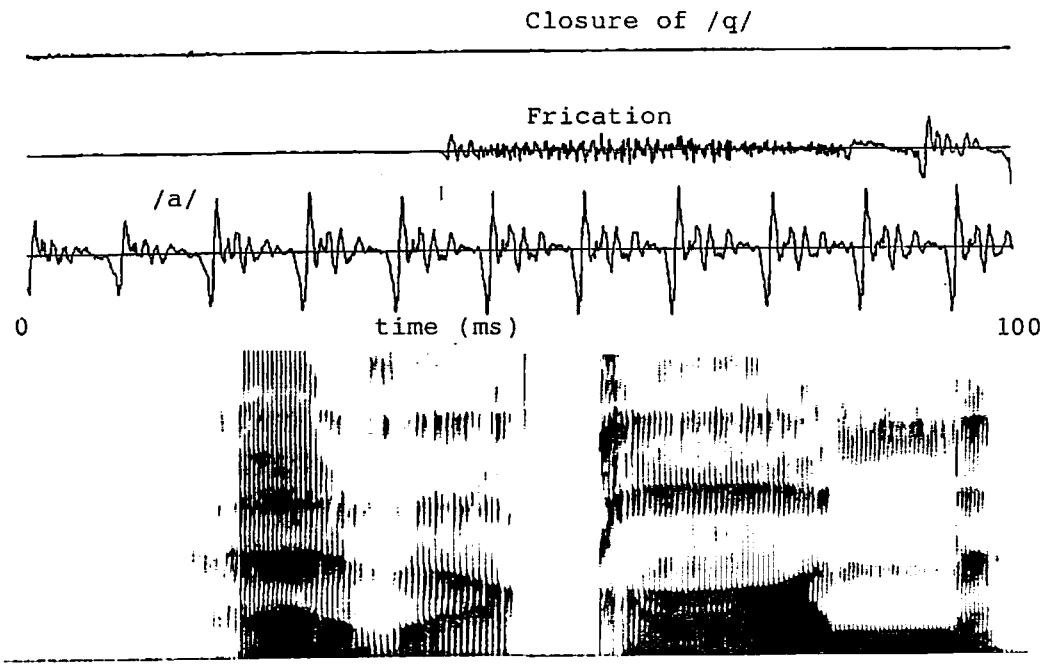

Fig.3.2 Frication following the closure of /q/ for sentence /haχaqa:l/ in wave form and sound spectrogram.

He defined the consonant as an uvular voiceless unaspirated stop in contrast with a velar voiceless aspirated stop /k/[3].

I suppose that it is inadequate to define the consonant /q/ as "an unaspirated consonant with no noise following the spike", because the frication is clear and the duration of the frication is not remarkably less than that of the aspiration after the burst of stop /k/ in the wave form observed in the present study. The other remarkable feature concerns the fact that the duration of the segment in a word depends on its position within the word.

Table 2. Duration of segments in four kinds of sentences.

Segment	Sentence1	Sentence2	Segment	Sentence3	Sentence4
ha	296.4	325.1	ha	232.0	261.5
ʔa	280.3	265.2	ʔa	262.9	246.6
k/q	124.8	142.7	l	72.6	92.1
Fric.	48.6	44.6	a:	191.3	202.0
a:	321.7	318.9	k/q	209.7	205.3
l	198.1	211.2	Fric.	28.0	29.1
*	86.8	77.5	*	70.1	63.3

Fric. ; Aspiration following closure of /k/ or frication following /q/

* ; Vowel-like sound[4]

Table 2 and Fig.4 show durations of all segments in sentences and words observed here. In Fig.4 the sign "h" is used for both the aspiration following consonant /k/ and frication following /q/ .The duration of /l/ and the closure of /k/ or/q/ are lengthened when each is in the final position of the sequence of /C1a:C2/ (C1,C2; consonant) compared with being in the initial position. As for the vowel /a:/, the duration becomes longer when it follows the consonant /k/ or /q/ compared with the case when it follows /l/. On the contrary the duration of the aspiration of /k/ or the frication of /q/ is also increased in the final position of sequence compared with the opening position.

Summary

1) F2 falling and F1 rising in neighboring vowels of consonant /q/ are remarkable. F1 or F2 of /k/ has no similar change as is the case of /q/.
2) The feature of formant of the vowel in the vicinity of /q/ is different from the one of "emphatic" consonant.
3) Frication is observed after the closure of /q/ and the duration of the frication has similar value to that of as an aspiration following the closure of /k/.
4) The falling of F2 of /q/ started approximately at the point of 23.8% and 38.7% of the duration of whole speech from the beginning when the consonant /q/ is in the first position of

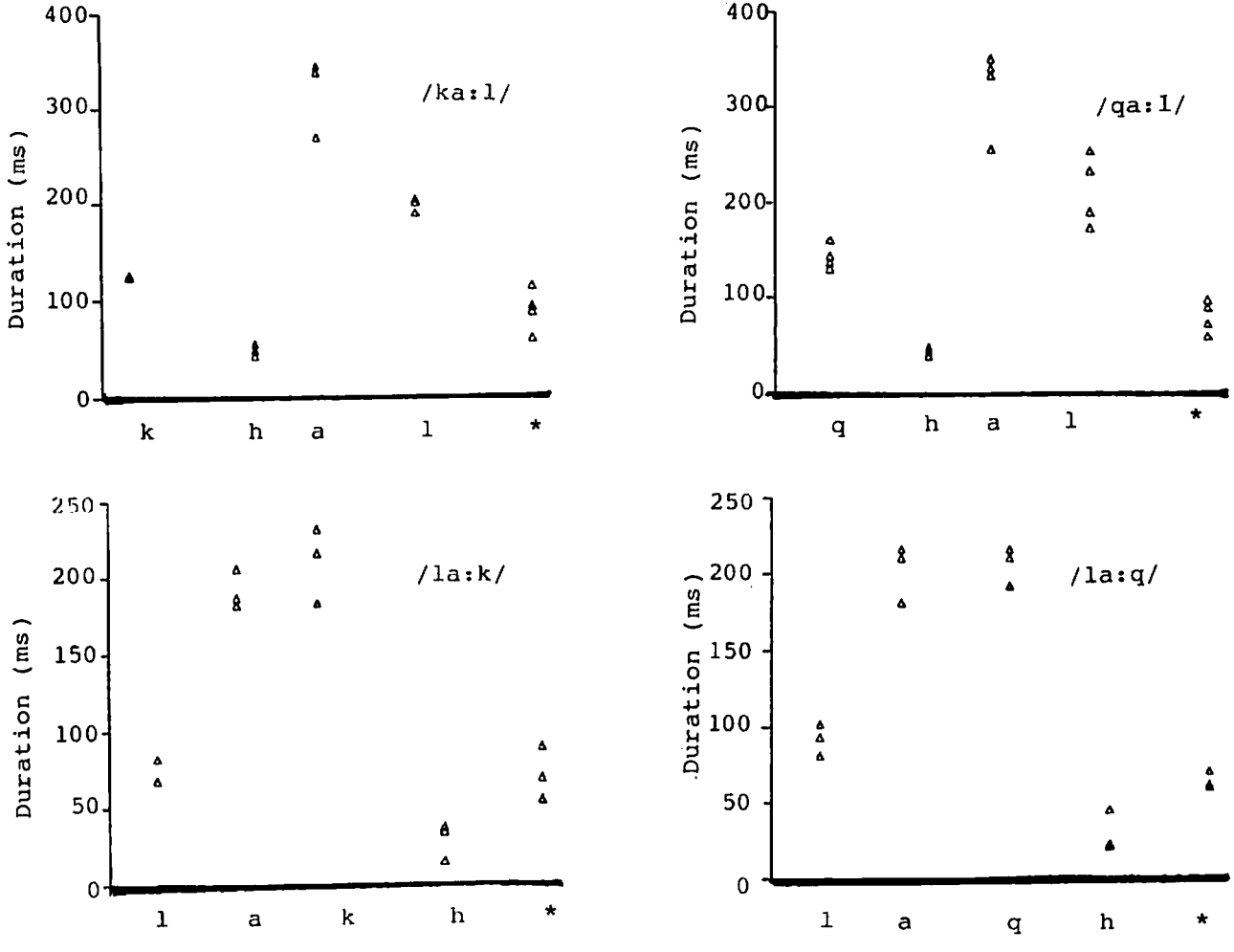

Fig.4 Duration of each segment in the words; /ka:l/, /qa:l/, /la:k/ and /la:q/. Here"h" is for frication and "*" for vowel-like sound.

sequence of phonemes of the word,namely /qa:l/, and in the end position, /la:q/,respectively.

5) It seems that the duration of segment depends on the position in sequence of phonemes to which the segment belongs.

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