DURATION OF VOWELS IN NOUNS IN THE CONSTRUCT STATE IN HEBREW

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1. Introduction

Every noun of the Hebrew language appears in one of three states: absolute, construct and with pronominal suffixes. Nouns in the construct state and with pronominal suffixes usually change their forms and vowel systems. The vowel sign 'EH' (one of the vowel signs of 'segol malé') in the word-final position of mascline, singular nouns in the absolute state changes to 'EEH' (one of the vowel signs of 'şere malé') for the singular form and 'EEI' (one of the vowel signs of 'şere malé') for the plural of the construct state, respectively. The vowel sign 'EH', whose phoneme is /e/, consists of the vowel sign 'segol' and the consonant letter of "hei" following the 'segol' as a quasi-vowel. The vowel sign 'EEH', whose phoneme is /e/, consists of the vowel sign 'şere' and "hei", a consonant letter of Hebrew, following 'şere' as a quasi-vowel. The vowel sign of 'EEI', whose phoneme is /e/, consists of the vowel sign 'şere' and the consonant letter "yod" following the 'şere' as a quasi-vowel[1-7].

This study discusses the differences in the duration of word-final vowels between the singular and plural forms of the construct state for certain nouns in actual speech.

2. Experiments

2.1 Preparation of test words

Three different words as governing nouns (ie,'nismax' in Hebrew)[1,7] and one word as a governed noun (ie, 'somex' in Hebrew)[1,7] were used for the test words. The governing nouns (in the construct state), the governed noun (in the absolute state) and their combined form (ie, 'smixut' in Hebrew)[1,7] are listed, using phonemic transcription in Table 1.

2.2 Procedures and method

The subject was a female, native speaker of Israeli Hebrew who was twenty-five years old. The test words were presented to her to read separately at a normal tempo in terms of her own speech more than three times. The recording was performed in an anechoic studio, and the speech sounds were then analyzed with an LPC analysis program[8]. The results were then processed by a SPSS program on the VAX-11/780 System.

2.3 Duration of vowels

Speech signals low pass-filtered with 4.5 kHz cut-off frequency were passed through A/D converters on a computer system and then displayed on a graphic display screen. Observing the speech signals there and listening to the speech sounds, the duration of the vowels in question was determined.

The onset of the wave form of each test word in combined form was at the beginning of the speech signal for consonant /m/. The offset of the wave form was at the end of the duration of the aspiration following the closure for the stop consonant /t/. The duration of the word-final vowel of a governing noun was defined as below (Fig.1).

2.3.1 /mumhepát/ (Fig.2)

The onset of vowel of /e/ was at the beginning of the periodical wave form for /e/, which followed the fricating wave form for the preceding consonant /h/. The end of the wave form for /e/ was defined as the boundary, which the closure for the consonant /p/ followed.

2.3.2 /maíasepát/ (Fig.3)

The onset of the vowel /e/ was at the beginning of the periodical wave form for /e/, which followed the fricating wave form for the preceding consonant /s/. The end of the wave for /e/ was defined as the boundary just before the onset of the closure for the consonant /p/ which followed the vowel /e/.

2.3.3 /mexabepát/ (Fig.4)

A periodical wave form, of small intensity, for the consonant /b/ changed to show a small amount of frication caused by the burst, which occurred after the closure of /b/ for the vowel of /e/. The onset of the vowel /e/ was at the beginning of the periodical wave form with strong intensity for /e/ which followed the wave form for the preceding consonant /b/. The end of the wave form for /e/ was defined as the boundary just before the onset of the closure for the consonant /p/ which followed the vowel /e/.

3. Results and discussion

The duration of the word-final vowel of governing nouns with a governed noun in the combined form was measured for both the singular and plural forms.

        Duration of noun in combined form: W(msec)
        Duration of governing noun: Y(msec)
        Duration of vowel /e/:   X(msec)
        Normalized value of X to W: $P=(X/W)\cdot100(\%)$
        Normalized value of X to Y: $Q=(X/Y)\cdot100(\%)$

Table 2 and Figs. 5,6,7,8 and 9 give the results for the above values. The difference of duration between the singular and plural form for the values W, X, Y, P and Q was examined via t-tests. Table 3 gives the results.

3.1 Difference in duration of nouns in the combined form (Fig. 4)

The difference in duration between the singular form (9 cases) and the plural one (14 cases) for three kinds of nouns in the combined form was examined. The difference was not significant at the level of $p < 0.05$ for any case.

3.2 Difference in duration of governing nouns in the construct state (Fig.6)

The difference in duration between the singular form (9 cases) and the plural (14 cases) for three kinds of governing nouns was examined. The difference was not significant at the level $p < 0.05$ for any comparison.

3.3 Duration of the word-final vowel /e/ for governing nouns in the construct state and their normalized values (Figs. 7,8,9)

The difference in duration of the vowel /e/ between the singular form (9 cases) and the plural (14 cases) for three kinds of governing nouns was examined. The difference was significant at the level of $p < 0.05$ for the mean and normalized values of the duration.

Concerning the normalized value of the duration of the vowel /e/, a remarkable difference was found between the singular and plural forms in the construct state for /mumhepát/ and /maſasepát/, while the difference was not so remarkable for /mexabepát/ though the duration of the vowel in question was still longer for in the plural form than in the singular.

4. Conclusion

A difference was found in the duration of vowels between the singular and plural forms for Hebrew muscline nouns in the construct state with the word-final vowel /e/. The duration of the vowel in question was longer in the plural form than in the singular for both mean and normalized values.

References

1. Greenberg, M. (1965); Introduction to Hebrew, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 34-37.
2. Ben-Ḥaim, Z. (1972); Encyclopaedia Judaica 8, Hebrew grammar, Keter Publishing House Jerusalem, Ltd., Jerusalem, 117-118.
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4. Netser, N. (1976); The vocalization rule and practice (in Hebrew), Massada Publications, Ramat Gan, 6-7.
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6. Kuriyagawa, F (1986); On the duration of vowels and the vowel signs in modern Hebrew, Journal of the Linguistic Society of Japan, 89, 21-40.
7. Ornan, U. (1978); Colloquial grammar (in Hebrew), Bronfman Publications, Tel Aviv, 25.
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Table 1: Test words transcribed by phonemically and their meanings.

Governing noun in the construct state

Word	s/pl	Meaning
/mumh̄é/	s	expert
/mumh̄é/	pl	experts
/maʃasé/	s	deed
/maʃasé/	pl	deeds
/mexabé/	s	extinguisher
/mexabé/	pl	extinguishers

Governed noun in the absolute state

Word	s/pl	Meaning
/ṕat/	s	a piece of bread

Combined forms of nouns in combination

/mumh̄eṕat/	s	expert of (or'for','in') a piece of bread
/mumh̄eṕat/	pl	experts of (or'for','in') a piece of bread
/maʃaseṕat/	s	deed of (or'for','in') a piece of bread
/maʃaseṕat/	pl	deeds of (or'for','in') a piece of bread
/mexabeṕat/	s	extinguisher of (or'for','in') a piece of bread
/mexabeṕat/	pl	extinguishers of (or'for','in') a piece of bread

Table 2: Mean values and normalized values of duration.

1. Mean values of nouns in combination (=W).

		Singular			Plural	
Word	No.	Mean	S.D.	No.	Mean	S.D.
/mumhepát/	3	1054.1	24.5	4	937.3	65.2
/maʃasepát/	3	999.3	20.3	3	997.6	35.9
/mexabepát/	3	977.7	16.8	7	996.6	33.8

2. Mean values of governing nouns (=Y).

		Singular			Plural	
Word	No.	Mean	S.D.	No.	Mean	S.D.
/mumhepát/	3	418.0	17.2	4	409.0	28.2
/maʃasepát/	3	437.5	19.9	3	462.9	21.8
/mexabepát/	3	445.9	23.5	7	473.3	7.2

3. Mean values of the word-final vowel /e/ of a governing noun (=X).

		Singular			Plural	
Word	No.	Mean	S.D.	No.	Mean	S.D.
/mumhepát/	3	125.0	3.6	4	157.1	17.4
/maʃasepát/	3	97.3	4.9	3	154.9	10.0
/mexabepát/	3	130.6	20.9	7	157.1	6.7

4. Normalized values of the vowel /e/: P=X/W·100(%)

		Singular			Plural	
Word	No.	%	S.D.	No.	%	S.D.
/mumhepát/	3	11.9	0.4	4	16.7	0.7
/maʃasepát/	3	9.7	0.6	3	15.5	0.6
/mexabepát/	3	13.3	1.9	7	15.8	0.6

5. Normalized values of the vowel /e/: Q=X/Y·100(%)

		Singular			Plural	
Word	No.	%	S.D.	No.	%	S.D.
/mumhepát/	3	29.9	0.5	4	38.3	2.0
/maʃasepát/	3	22.3	1.6	3	33.5	0.7
/mexabepát/	3	29.2	3.3	7	33.2	0.9

Table 3: Difference in duration at the level (p<0.05).

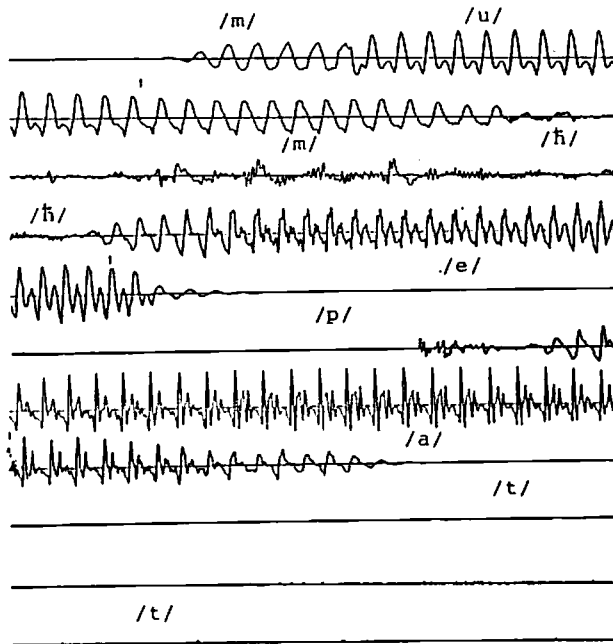|		Singular			Plural		Significance
	No.	Mean	S.D.	No.	Mean	S.D.	Probability
W(msec)	9	1010.4	38.6	14	979.9	49.9	0.115
Y(msec)	9	433.8	21.5	14	452.7	33.4	0.149
X(msec)	9	117.7	18.9	14	156.7	10.3	0.000*
P(%)	9	11.6	1.9	14	16.0	0.8	0.000*
Q(%)	9	27.1	4.1	14	34.7	2.7	0.000*

*: significant

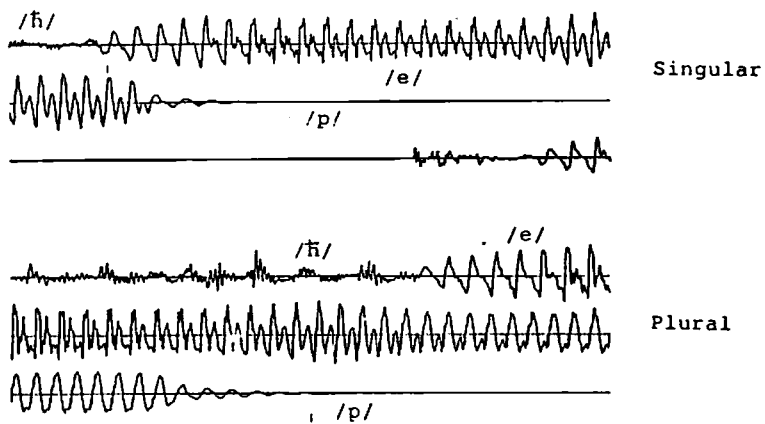Fig.1 Wave form for /mumħepát/(/mumħé/ :singular).
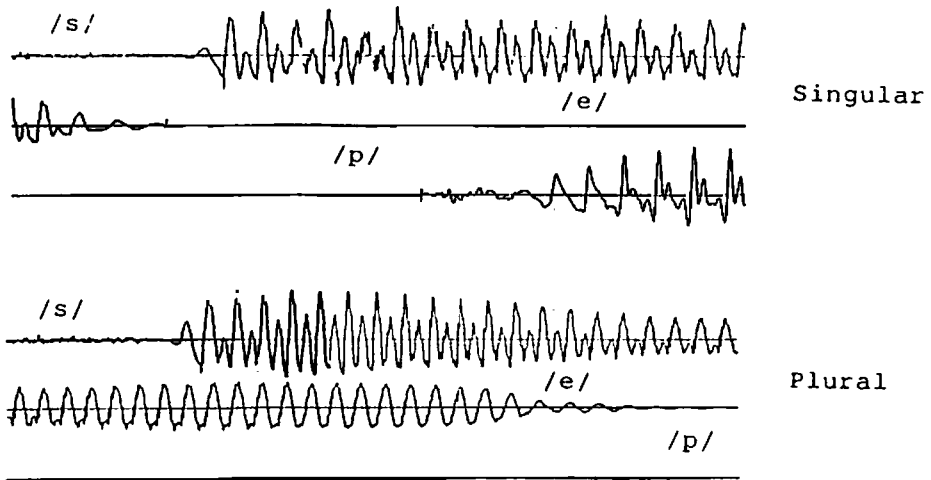
Fig.2 Wave form for /e/ in./mumħepát/.

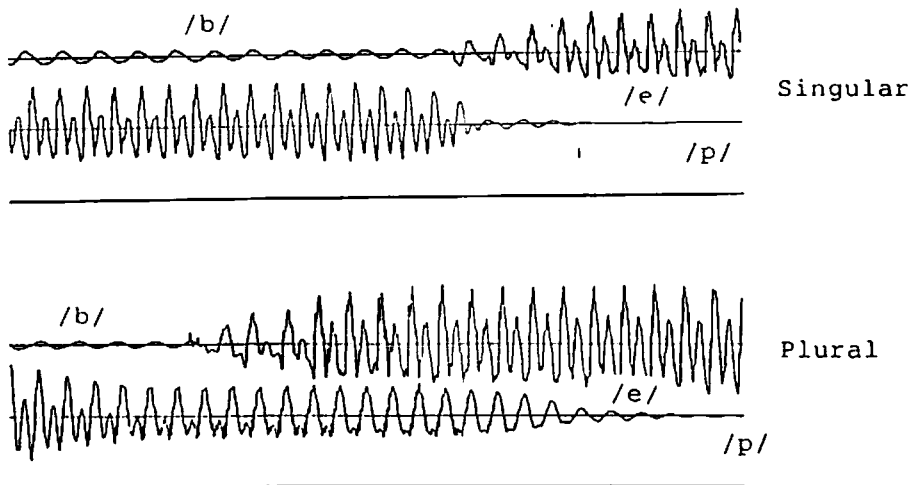Fig.3. Wave form for /e/ in /maʕasepát/.
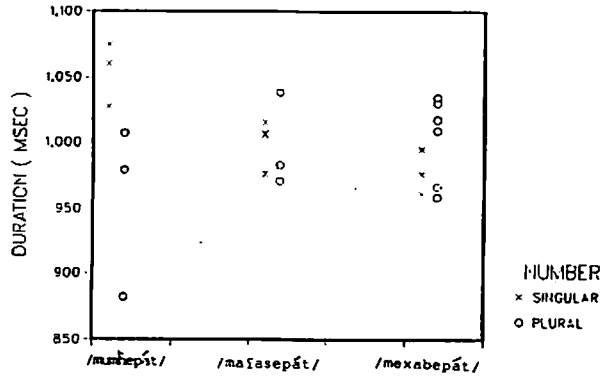

Fig.4. Wave form for /e/ in /mexabepát/.

Fig.5 Duration of the combined form of a governing noun
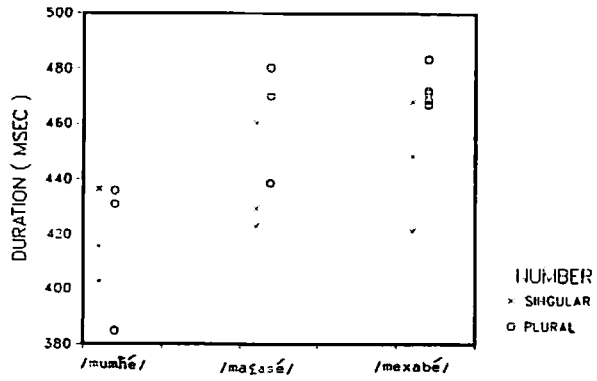and a governed noun.
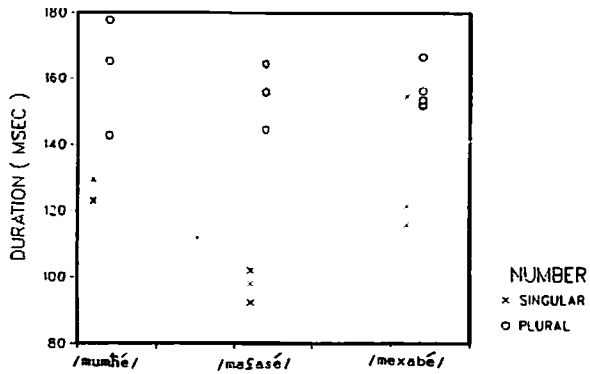
Fig.6 Duration of the governing noun of a combined form.

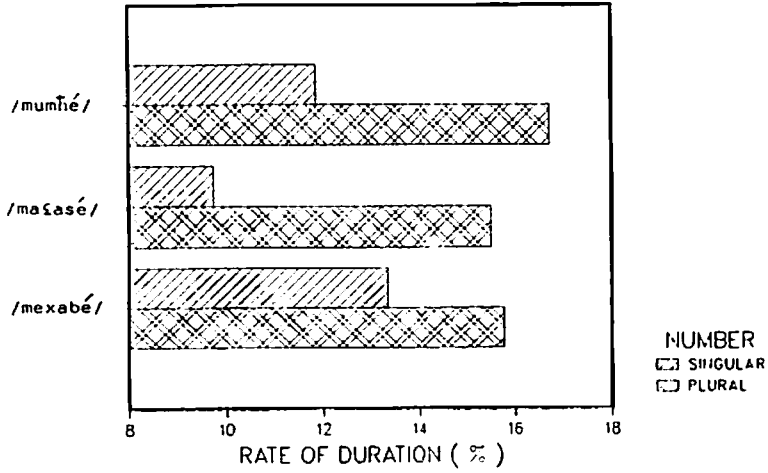Fig.7 Duration of the word-final vowel of a
governing noun.

Fig.8 Rate of duration of the word-final vowel /e/ of
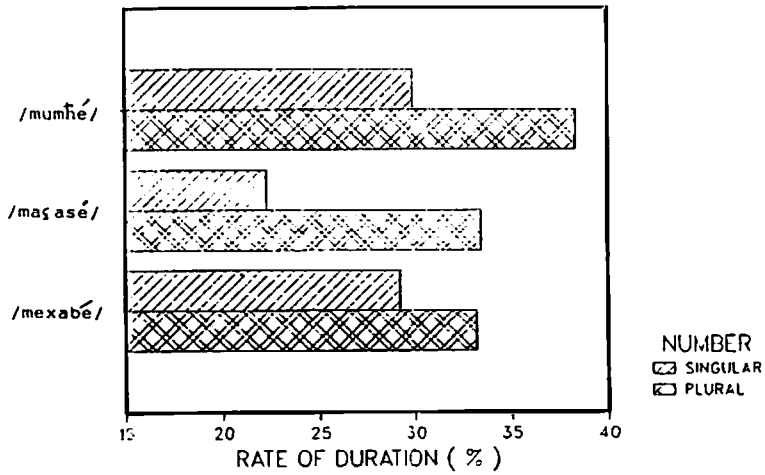a governing noun to the duration of the combined form

Fig.9 Rate of duration of the word-final vowel /e/ of
a governing noun to the duration of the governing noun.