THE INFLUENCE OF THE DIMINUTIVE SUFFIX ON THE PRECEDING VOWEL

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1. SUMMARY

Does the Dutch diminutive suffix -[jə] exert an influence on the vowel or diphthong of the preceding syllable resulting in vowel mutation?
The Dutch vowel system consisting of 12 vowels and 3 diphthongs has been investigated in order to answer this question.
The vowels and diphthongs were recorded in a fixed environment, viz. [b] -[t] and [b] -[tjə], resulting in 15 pairs of items. Each item was measured for the vowel duration, the pre-consonantal duration and at three different moments for its basic frequency and its first and second formant. On the basis of the results vowel mutation might be defined as shortening of the vowel duration, rising of the basic frequency and shifting of the formants in the direction of those of [i] or [j] under the influence of [i] in the following unstressed syllable.

2. INTRODUCTION

Mutation, for which Grimm first used the term "Umlaut", is the change from one vowel to another through the influence of a vowel in an immediately following syllable.
The kind of mutation under consideration is the one called "i-mutation", together with the closely related change called "raising". Both seem to be the result one way or another, of the influence of an [I] or [j] in the following weakly stressed syllable. The difference between the two is that the term

"raising" is only applied to the change from (e) to (i), observable in a spelling change, while "i-mutation" is the "fronting" or "raising" (both articulatory concepts) of other vowels that can be subject to this change.

"Raising" of (e) to (i) is a common Germanic mutation, e.g.: Greek ἔστι 'is', as opposed to Gothic, Old-Saxon, Old High German <u>ist</u>, and Old English <u>is</u>, and Latin medius 'middle', as opposed to Gothic <u>midjis</u>, Old Icelandic <u>miðr</u>, Old Saxon <u>middi</u>, Old English <u>midd</u>, and Old High German <u>mitti</u>.

"i-mutation" is a change shared in varying degrees by all Germanic languages except Gothic, e.g. Old English <u>here</u>, cf. Gothic <u>harjis</u>, 'army'; Old English <u>bed</u>, cf. Gothic <u>badi</u>, 'bed'.

Old English plural <u>fēt</u> as opposed to the singular <u>fōt</u>, cf. Gothic plural <u>fōtjus</u> 'feet'.

Modern High German <u>Hände</u> as opposed to the singular <u>Hand</u> cf. Gothic plural <u>handjus</u> 'hands'.

Whether the [I] or [j] does in fact exert a direct influence on the preceding vowel remains a point of discussion among scholars. Three explanations seem possible:

2.0.1 Many scholars (Sievers and Luick among the 19th century philologists, Rooth among the contemporary ones) are of the opinion that the [I] or [j] "palatalized" the preceding consonant and that this palatalized consonant in turn pulled the vowel of the stem towards its own position, raising or fronting it. "Palatalization" is defined as a shift in the place of articulation towards the hard palate. This may be called a 'mechanistic' theory, because it is based entirely on the assumed workings of the speech-organs.

2.0.2 According to a second explanation the speaker unconsciously anticipates the [I] or [j] that is to come in pronouncing the vowel of the root-syllable and the sound first resulting is the original vowel plus an anticipatory high front vowel which eventually coalesced with the original stem-vowel. This theory gives a 'psychological' explanation for mutation as defined above.

2.0.3 A third theory occupies a half-way house between the two already mentioned. This theory holds that mutation was brought about by the joint working of the 'mechanistic' and 'psychological' influences, viz. that the [I] or [j] pulled the immediately preceding consonant towards a palatal articulation and that this in turn mutated the stem-vowel, while at the same time this vowel was being affected by the anticipation of the [I] or [j].

2.1 With all this in mind the question arose if an environment optimal for the occurrence of mutation could be found. The best environment seemed to be the Modern Dutch diminutive ending -[jə], which fully answered the requirements for mutation.

3. RESEARCHPROBLEM

We wanted to investigate what happens when the diminutive ending is added to the headword. It is clear that a comparative analysis was needed. In order to exclude as many disturbing factors as possible, it was decided to fix the environment at [b]-[t] and [b]-[tjə], with such items as bot-botje. Female voices were excluded in order to arrive at material as uniform as possible. It seemed best to model the inquiry on "Comparative phonetic vowel analysis" by F.J. Koopmans-van Beinum, (1973).
Consequently the same measuring apparatus was chosen.

4. METHOD OF DATA COLLECTING

Recordings were made of five male speakers. No attempt was made to arrive at a group of standard Dutch, because this investigation was meant to be of an exploratory nature. Modern Dutch has 12 vowels and 3 diphthongs, each of which was used in the environments [b]-[t] and [b]-[tjə] amounting to a total of 30 words.

Traditionally these vowels are classified into short [ɔ], [ɑ] [œ], [I] and [ε], half-long [u], [y] and [i], and long [o], [a], [ø] and [e].

The subjects of the experiment had been asked to pronounce the words as naturally as possible and they knew that there were some nonce-words amongst them.

The words had been produced on cards, the order of which had been randomized to avoid the occurence of pairs. Some blank cards had been added to the end of the stack to avoid a possible drop in pitch. A phonetic notation of the vocalic elements plus the words chosen for this inquiry follows:

(It should be noted that syllable-final /d/ is realized in Modern Dutch as [t].)

1. [u] in [1]boet(je)	(approximately the vowel of French fou).
2. [o] in boot(je)	(approximately the vowel of French beau).
3. [ɔ] in bot(je)	(approximately the vowel of French coq).
4. [ɑ] in bad(je)	(approximately the vowel of French las).
5. [a] in baat(je)	(approximately the vowel of French grave).
6. [y] in buut(je)	(approximately the vowel of French mur).
7. [ø] in [2]beut(je)	(approximately the vowel of French peu).
8. [œ] in [2]but(je)	(approximately the vowel of French que).
9. [i] in biet(je)	(approximately the vowel of French si).
10. [I] in bit(je)	(approximately the vowel of English lip).
11. [e] in beet(je)	(approximately the vowel of French né).
12. [ε] in bed(je)	(approximately the vowel of French bec).
13. [au] in bout(je)	(approximately the diphthong of English house).
14. [ʌy] in buit(je)	for which no approximations can be found.
15. [εi] in bijt(je)	

Note: All the words are common Dutch nouns, except for the one marked [1], which is a noun of regional origin and those marked [2], which are nonce-words.

The recording was made at the Institute of Phonetic Sciences with an Ampex tape-recorder (type 300) and a Philips microphone (type EL 6031/00).

4.1 Measuring the material.

A copy was made of the recording described above and this was rendered on the IFA-gate. One of the possibilities of this apparatus is an unlimited repetition of a very small, carefully chosen segment of the recorded signal. This made it possible for the present investigation to "lift" the vowel or diphthong out of its consonantal environment, so that the sound curve of this vowel segment could be made visible on the screen of an oscilloscope.
For this purpose a storage-oscilloscope was used (Tectronix, type RM 564, with an amplifier, type 3 A72 and a time-base, type 3B3), which stores the sound curve on a phosphorescent screen, so that measurements can be taken directly from the screen.
The starting-point, viz. the fact that a sound curve of a vowel is composed of natural frequencies superimposed on one another, suggested a method of formant measurement from the distribution of zero-crossings.
Because the object of this experiment was to find out whether a difference arises in the frequencies of a vowel, when followed by the diminutive ending, it was thought expedient to measure formants directly from the sound curve of every vowel or diphtong at three different places. First the duration of the vowel and the duration of the "pre-consonantal" were measured in milliseconds. The vowel is considered to start immediately after the plosion of the [b], where the formant pattern is clearly visible for the first time. The "pre-consonantal" is considered to be that part of the signal, beginning where the vowel proper ends, i.e. where the formant pattern becomes indistinct and terminating where the plosion of the [t] becomes visible. At times it was difficult to decide where the pre-consonantal ended because in the words with the diminutive ending a stretch of noise sometimes preceded the plosion of the [t]. The duration of this

stretch of noise has not been added to that of the pre-consonantal.

The first measurement was taken at about 10 ms, the second somewhere halfway the vowel and the third as closely as possible to the end.

Occasionally, when the vowel was extremely short or in the case of much damping it was impossible to choose the three moments more than 20 ms apart.

The basic frequency and the first and second formant were measured in Hz. Especially in words with [ɔ] and [o] the second formant was often hard to ascertain.

5. MATERIAL PROCESSING

5.1 Computations were carried out of mean values and standard deviations of the duration of the vowels or diphthongs and of the pre-consonantal duration for the two types (Tables I and II).
The mean values of the vowel and pre-consonantal duration were plotted in graphs (Figs. 1 and 2). Fig. 3 shows a diagram of the sum of the mean values of the duration of the vowel or diphthong plus that of the pre-consonantal. The order of the items in Fig. 1 was chosen in such a way as to render a rising line for the normal vowel, the diphthongs being grouped together, and furthermore the [I] being placed before the group [u], [y] and [i], traditionally termed the half-long vowels. In Figs. 2 and 3 the order is the same.

5.2 Separate computations were made of the mean values and standard deviations at each of the three places of measurement of the basic frequency and of the first and second formant (Tables III-VIII). The mean values of the basic frequency at each of the three places of measurement for the two types of words were plotted (Fig. 4). The same was done for the first and second formant (Fig. 5 and 6).

6. RESULTS AND CONCLUSIONS

Results are summarized in figures and tables.

6.1 Results in detail.

6.1.1 Figure 1 showing the mean values of vowel duration makes clear that the vowel or diphthong becomes shortened when followed by the diminutive ending.
Fig. 2 showing the mean values of the duration of the pre-consonantal generally offers a similar picture.
Fig. 3 in which the mean values of the pre-consonantal were added to those of the vowels, makes clear that the duration of the vocalic stretch is shorter in the case of mutated vowels.

6.1.2 Fig. 4 shows the mean values of the basic frequency at each of the three places for both types of words. As a rule the basic frequency is higher when the suffix is added. The vowels [u], [y] and [i], being those with a low first formant, show a marked difference.
Generally the F_0-pattern is rising-falling for both types.

6.1.3 Fig. 5 shows the formant structure of the vowels and diphthongs at the three places of measurement without the diminutive suffix. The simple vowels remain more or less constant whereas the diphthongs shift clearly in their F_1.
Fig. 6 shows the formant structure of the vowels and diphthongs at the three places of measurement with the diminutive suffix added. Here all the vowels shift in the direction of [i̯] resulting in positions associated with other vowels without the diminutive suffix, e.g. [u] → [y], [y] → [i], [o] → [œ]. The diphthongs however only shift in their F_1 just following their normal diphthonga movement, but "overshooting" as it were their target without the diminutive ending.

6.2 Conclusions.

Drawing conclusions from the results described above is of course not free from risks because of the scantiness of the

material, some 400 measurements in all.
Moreover, for each vowel or diphthong only one key-word per speaker was recorded. Strictly speaking, the results apply only to vowels and diphthongs in the environment [b] - [t] and [b] - [tjə]. However with these considerations in mind the following conclusions seem justified.

6.2.1 Turning to the results mentioned under 6.1.1 we may conclude that there seem to be no grounds to stick to the traditional classification of vowels in three groups, short ([ɔ], [α], [œ], [I], [ε]), half-long ([u], [y], [i] and long ([o], [a], [ø], [e]) (cf. Fig. 1).
From our results the only short vowel would have to be [α], the half-longs [u], [ɔ], [y], [œ], [i], [I], [ε] while [o], [a], [ø], [e] and the diphthongs would have to be called long.
In the authors' opinion a twofold division would be better: short and long vowels.
We may conclude from Figs. 1, 2 and 3 that the duration of the vocalic stretch is shorter in the case of diminutives, which fits in with the general rule that vowels in multisyllables are shortened in Dutch (Nooteboom, 1972).

6.2.2 No explanation seems available for the generally higher value of the basic frequency in words with the diminutive suffix, unless we want to conclude that in disyllabic words stressed syllables have a higher basic frequency than their monosyllabic counterparts (cf. Fig. 4).
The high basic frequency of [u], [y] and [i] when the diminutive suffix is added may be related to the fact that these three vowels shift only in their F_2.

6.2.3 From the results detailed under 6.1.3 we may conclude that the diminutive suffix does have an influence on the preceding vowel including [I] and [i]. According to philologists these two vowels would not be subject to mutation. Fig. 6 shows that [I] and [i] change just as

the other vowels. The explanation for the fact that no sign of mutation is found in these cases may be merely a matter of spelling. Moreover we may conclude that although from the outset of the vowels there is a difference between the two types of words, the change becomes clearest towards the end of the vowels.
What we said under 6.1.3 concerning the shift of the formant pattern to values associated with another vowel not followed by the diminutive suffix, seems to tally with the traditional rules, that [u], when mutated becomes [y] (cf. German Huhn - Hühnchen), [ɑ] becomes [ɛ] after mutation (cf. German Band - Bändchen), etc.
Why the diphthongs should "overshoot" their target in case of diminutives is not clear. Perhaps there is a connection between this fact and the fact that their F_2 does not change.
Mutation in the case of the Dutch diminutive suffix -[jə] is the change of the vowel by which the vowel becomes shortened, the basic frequency is raised, the first formant decreases in value or remains constant in case it is low and finally the second formant increases under the influence of a [j] after an intervening consonant.
The Dutch diphthongs [ɑu], [ʌy] and [ɛi] seem to be less sensitive to mutation.

7. DISCUSSION

7.1 In the introduction instances have been given of mutation in various Germanic languages. It should be realized that mutation can only be observed diachronically.
The term "mutation" is used when a change in spelling has consistently been carried through in what must be the same word. A change in pronunciation is then supposed to have preceded this change in spelling. In other words "mutation" in phonology

is something at the mercy of orthographists.
On the acoustic facts described in this report a change in spelling in Dutch diminutives could be based, although the criteria for a change in spelling are unknown. An objection could be that there is no reason for a spelling change as you can not help but pronounce a sequence like '<u>badje</u>' with co-articulation of the [α] and the [j].

7.2 None of the theories explaining mutation (cf. Introduction 2.0.2.0.3) can be favoured on the basis of the results of this investigation because they are not formulated in acoustic term Moreover the second theory is fully, the third partly psychological.

7.3 As many factors seem to show various interrelations a multiple variance analysis will be carried out.
We think it useful to extend the investigation to other keywords and words in connected speech.

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TABLE I: Mean values and standard deviations of vowel duration and pre-consonantal duration, without the diminutive ending.

	DUR.	SD.DUR.	PAUSE	SD.PAUSE
u	120.0	18.5	48.0	27.8
o	164.0	18.0	60.0	12.6
ɔ	118.0	7.7	50.0	21.4
ɑ	106.0	10.5	66.0	28.7
a	177.0	18.4	76.0	21.5
y	121.0	12.4	47.0	31.3
ϕ	180.0	30.7	57.0	37.1
œ	118.0	12.5	42.0	27.1
i	127.0	12.0	44.0	29.1
I	125.0	18.5	51.0	29.3
e	158.0	27.3	58.0	30,4
ɛ	117.0	13.3	66.0	21.3
au	160.0	17.3	65.0	22.4
ʌy	170.0	21.7	70.0	22.9
ɛi	176.0	26.6	89.0	51.2

TABLE II: Mean values and standard deviations of vowel duration and pre-consonantal duration, with the diminutive ending.

	DUR.	SD.DUR.	PAUSE	SD.PAUSE
u	109.0	10.5	23.0	10.1
o	152.0	20.0	53.0	20.0
ɔ	102.0	23.2	42.0	13.7
ɑ	93.0	8.4	66.0	19.1
a	163.0	13.7	65.0	24.0
y	119.0	8.2	28.0	29.0
ϕ	157.0	23.0	53.0	44.1
œ	111.0	11.5	40.0	26.1
i	112.0	20.0	36.0	13.6
I	108.0	12.0	57.0	36.0
e	141.0	17.4	44.0	45.6
ɛ	111.0	11.5	65.0	24.4
au	152.0	10.1	62.0	27.5
ʌy	152.0	18.6	73.0	18.6
ɛi	165.0	15.3	58.0	27.3

TABLE III: Mean values and standard deviations of the basic frequency, the first and second formant at the first place of measurement, without the diminutive ending.

	F_1	$SD.F_1$	F_2	$SD.F_2$	F_0	$SD.F_0$
u	359.0	32.8	981.0	109.6	125.0	15.0
o	465.0	35.8	964.0	115.8	123.0	13.5
ɔ	454.0	42.7	982.0	40.2	123.0	12.0
α	563.0	69.7	1128.0	119.4	124.0	12.9
a	661.0	49.2	1486.0	76.0	117.0	13.5
y	318.0	17.1	1681.0	188.5	128.0	16.8
ø	406.0	69.4	1577.0	118.8	128.0	10.3
œ	391.0	32.8	1559.0	99.3	126.0	13.8
i	295.0	14.1	2384.0	118.4	121.0	10.8
I	357.0	17.8	2121.0	216.6	118.0	9.0
e	409.0	50.7	2068.0	175.8	119.0	17.8
ε	541.0	52.1	1827.0	234.9	120.0	20.3
au	597.0	47.6	1180.0	121.6	117.0	17.1
ʌy	590.0	82.7	1554.0	288.6	115.0	19.6
εi	583.0	43.8	1932.0	118.3	116.0	12.9

TABLE IV: Mean values and standard deviations of the basic frequency, the first and second formant at the first place of measurement, with the diminutive ending.

	F_1	$SD.F_1$	F_2	$SD.F_2$	F_0	$SD.F_0$
u	332.0	27.2	888.0	120.2	144.0	17.1
o	448.0	35.2	951.0	108.3	119.0	10.8
ɔ	474.0	38.3	1071.0	100.2	128.0	9.0
α	607.0	66.8	1247.0	140.3	122.0	14.8
a	646.0	46.9	1455.0	86.7	114.0	13.8
y	301.0	23.8	2034.0	193.0	142.0	10.9
ø	365.0	34.6	1643.0	128.2	120.0	10.6
œ	387.0	46.0	1695.0	69.9	126.0	15.5
i	288.0	20.7	2559.0	312.8	146.0	6.5
I	345.0	26.4	2244.0	250.3	122.0	10.3
e	383.0	43.8	2073.0	168.5	133.0	4.4
ε	533.0	30.1	1820.0	193.3	126.0	15.5
au	580.0	65.0	1243.0	119.7	121.0	19.1
ʌy	576.0	31.3	1636.0	233.7	118.0	15.2
εi	598.0	68.9	1926.0	68.3	118.0	11.5

TABLE V: Mean values and standard deviations of the basic frequency, the first and second formant at the second place of measurement, without the diminutive ending.

	F_1	$SD.F_1$	F_2	$SD.F_2$	F_0	$SD.F_0$
ʉ	349.0	21.9	944.0	128.9	129.0	20.1
o	451.0	32.2	956.0	119.2	123.0	19.2
ɔ	459.0	47.0	946.0	49.2	124.0	16.3
ɑ	604.0	86.0	1133.0	128.1	123.0	14.8
a	690.0	63.4	1430.0	0.4	123.0	18.9
y	299.0	21.9	1866.0	183.4	135.0	23.4
ø	419.0	40.9	1678.0	34.7	130.0	9.3
oe	391.0	13.4	1579.0	130.4	130.0	13.6
i	296.0	27.0	2505.0	261.7	127.0	12.5
ɪ	349.0	26.0	2220.0	269.4	120.0	12.7
e	403.0	55.8	2165.0	208.1	120.0	21.2
ɛ	569.0	54.9	1905.0	198.9	121.0	19.1
au	647.0	68.3	1174.0	148.5	120.0	15.4
ʌy	632.0	82.5	1486.0	175.0	122.0	17.5
ɛi	591.0	51.2	2109.0	110.0	117.0	12.0

TABLE VI: Mean values and standard deviations of the basic frequency, the first and second formant at the second place of measurement, with the diminutive ending.

	F_1	$SD.F_1$	F_2	$SD.F_2$	F_0	$SD.F_0$
u	308.0	25.3	1046.0	161.6	153.0	21.9
o	449.0	46.5	1068.0	135.3	126.0	18.5
ɔ	450.0	41.2	1273.0	241.8	125.0	10.0
ɑ	627.0	73.2	1555.0	247.2	127.0	16.8
a	675.0	58.7	1518.0	105.3	123.0	20.1
y	285.0	14.1	2249.0	395.0	137.0	15.2
ø	387.0	38.9	1726.0	85.8	125.0	13.2
œ	363.0	30.3	1874.0	237.6	132.0	18.2
i	293.0	14.1	3074.0	551.9	142.0	6.7
ɪ	351.0	38.4	2372.0	244.2	126.0	12.9
e	387.0	40.8	2287.0	584.8	132.0	9.0
ɛ	576.0	37.8	2020.0	229.3	131.0	16.3
au	589.0	35.0	1258.0	43.8	128.0	21.6
ʌy	583.0	38.3	1720.0	257.2	121.0	10.8
ɛi	544.0	24.5	2114.0	162.7	123.0	14.8

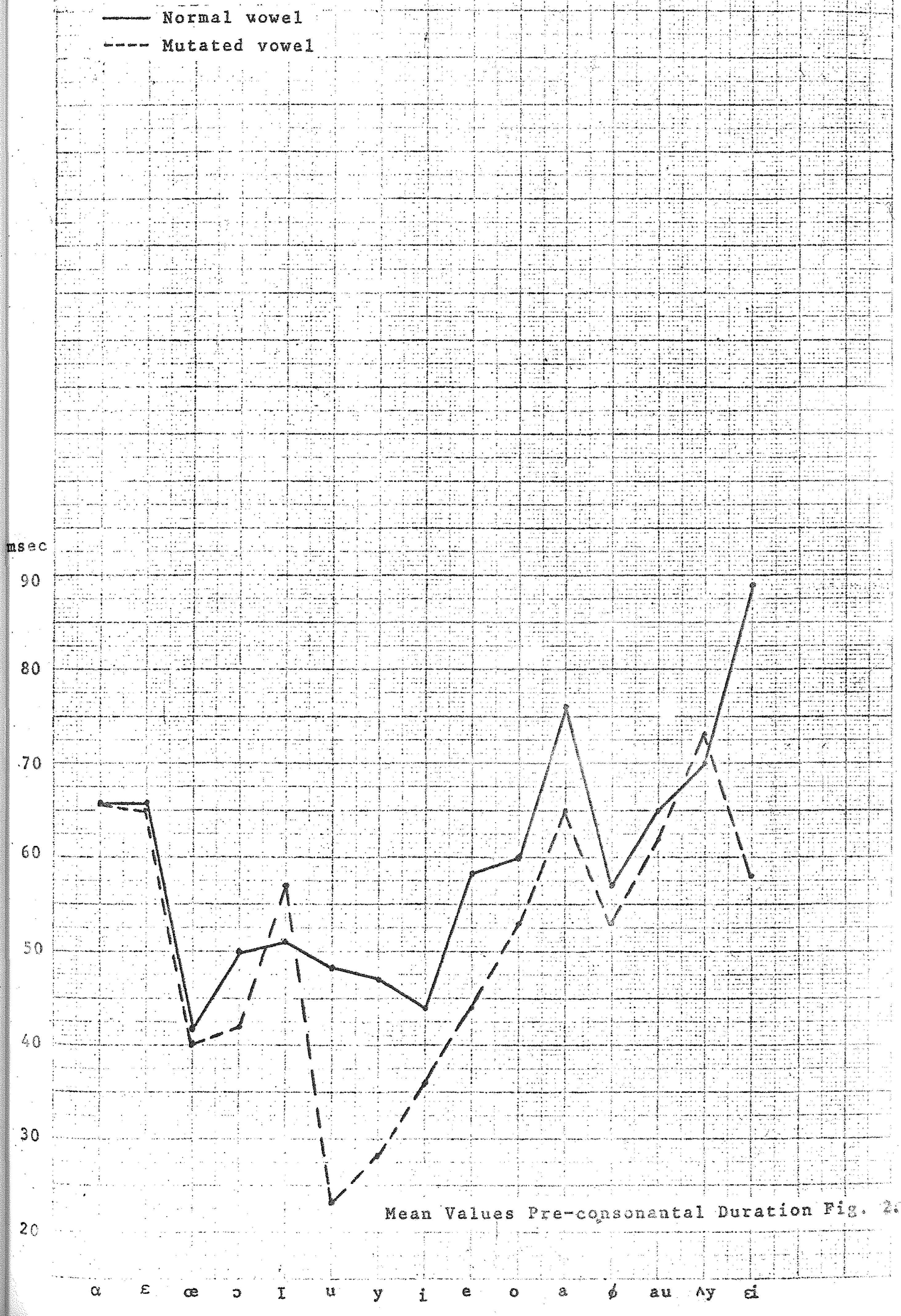
TABLE VII: Mean values and standard deviations of the basic frequency, the first and second formant at the third place of measurement, without the diminutive ending.

	F_1	$SD.F_1$	F_2	$SD.F_2$	F_0	$SD.F_0$
u	332.0	34.2	966.0	172.6	121.0	26.3
o	413.0	38.3	923.0	126.6	118.0	19.5
ɔ	475.0	83.6	982.0	53.5	123.0	13.5
α	558.0	44.3	1042.0	93.9	119.0	11.4
a	661.0	80.1	1439.0	75.6	110.0	13.6
y	293.0	17.8	2048.0	276.6	125.0	18.3
ø	355.0	30.8	1770.0	101.6	113.0	4.4
œ	365.0	34.6	1543.0	196.0	123.0	13.0
i	274.0	17.1	2718.0	247.2	120.0	14.5
I	348.0	12.0	2144.0	220.6	124.0	12.4
e	361.0	39.7	2370.0	366.7	111.0	20.7
ε	527.0	27.5	1807.0	144.7	117.0	18.2
au	552.0	103.4	1094.0	173.3	118.0	18.2
ʌy	488.0	70.3	1619.0	116.7	113.0	19.5
εi	479.0	49.4	2447.0	341.3	113.0	7.5

TABLE VIII: Mean values and standard deviations of the basic frequency, the first and second formant at the third place of measurement, with the diminutive ending.

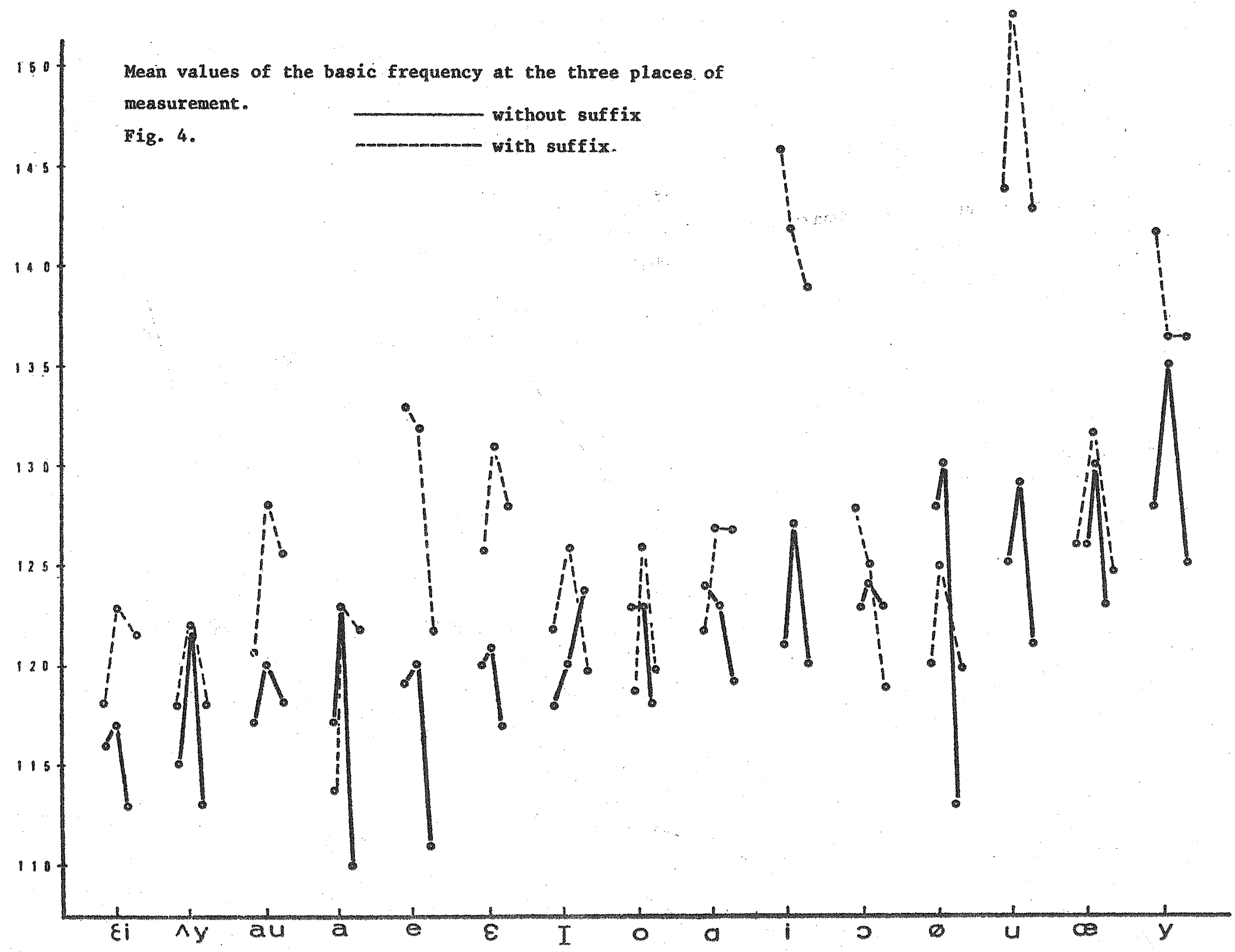
	F_1	$SD.F_1$	F_2	$SD.F_2$	F_0	$SD.F_0$
u	301.0	48.1	1959.0	434.6	143.0	18.9
o	363.0	30.3	1301.0	250.6	120.0	16.9
ɔ	388.0	30.7	1599.0	279.0	119.0	11.9
α	505.0	11.1	2030.0	566.4	127.0	17.5
a	615.0	115.5	1762.0	138.2	122.0	18.2
y	288.0	26.3	2556.0	422.3	137.0	13.0
ø	352.0	50.1	2144.0	220.6	120.0	13.6
œ	340.0	49.4	2198.0	225.4	125.0	15.4
i	281.0	8.2	3692.0	340.3	139.0	8.9
I	329.0	38.6	2850.0	314.7	120.0	14.5
e	355.0	60.0	2992.0	212.2	122.0	16.0
ε	458.0	71.4	2651.0	542.6	128.0	20.1
au	379.0	49.2	1239.0	80.9	126.0	15.5
ʌy	354.0	59.2	1897.0	151.3	118.0	11.5
εi	357.0	41.4	2502.0	421.2	122.0	9.0

Mean Values Vowel Duration. Fig. 1.



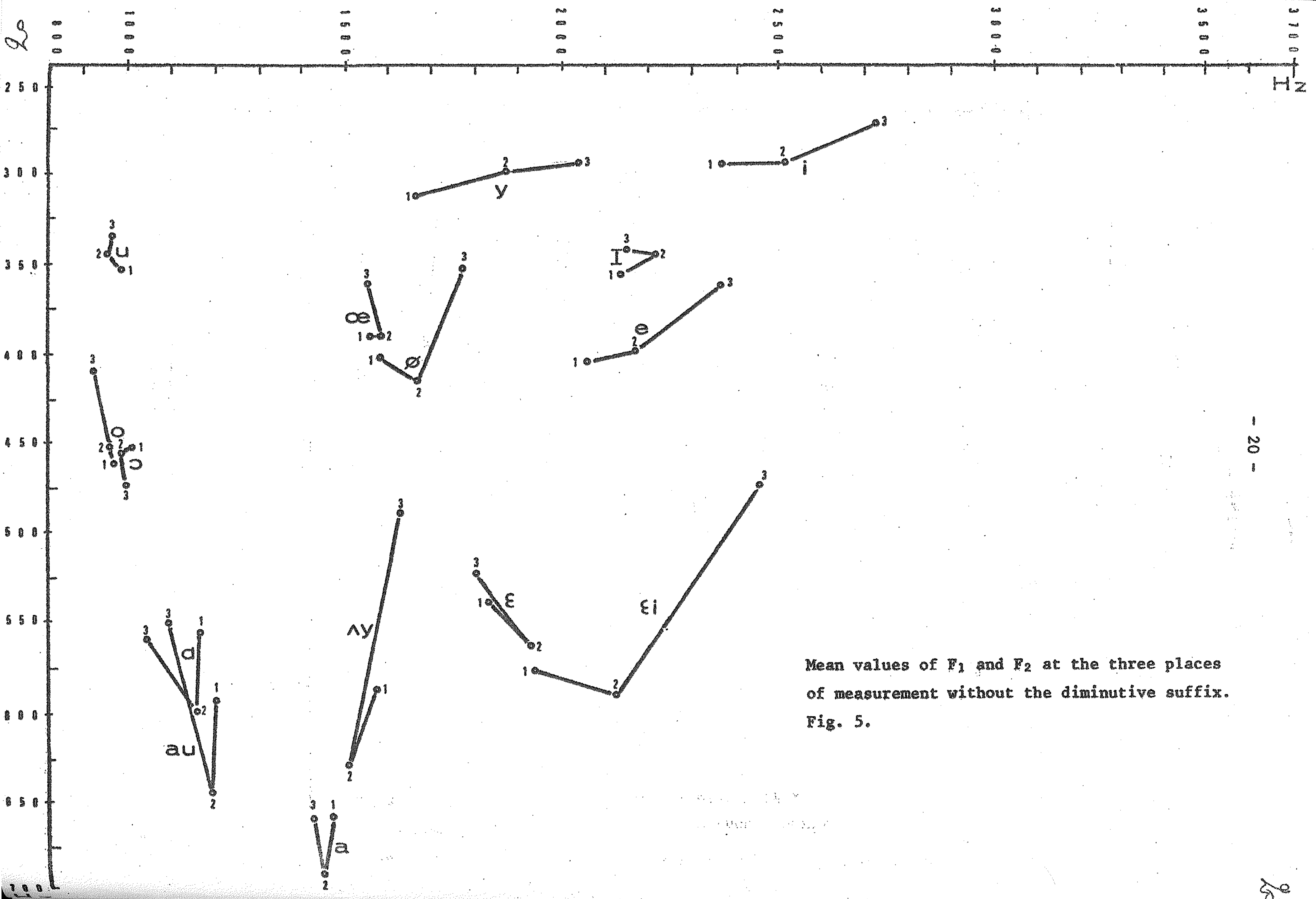
Mean Values Pre-consonantal Duration Fig. 2

Mean Values Vowel Duration plus Pre-Consonantal Duration. Fig. 3.

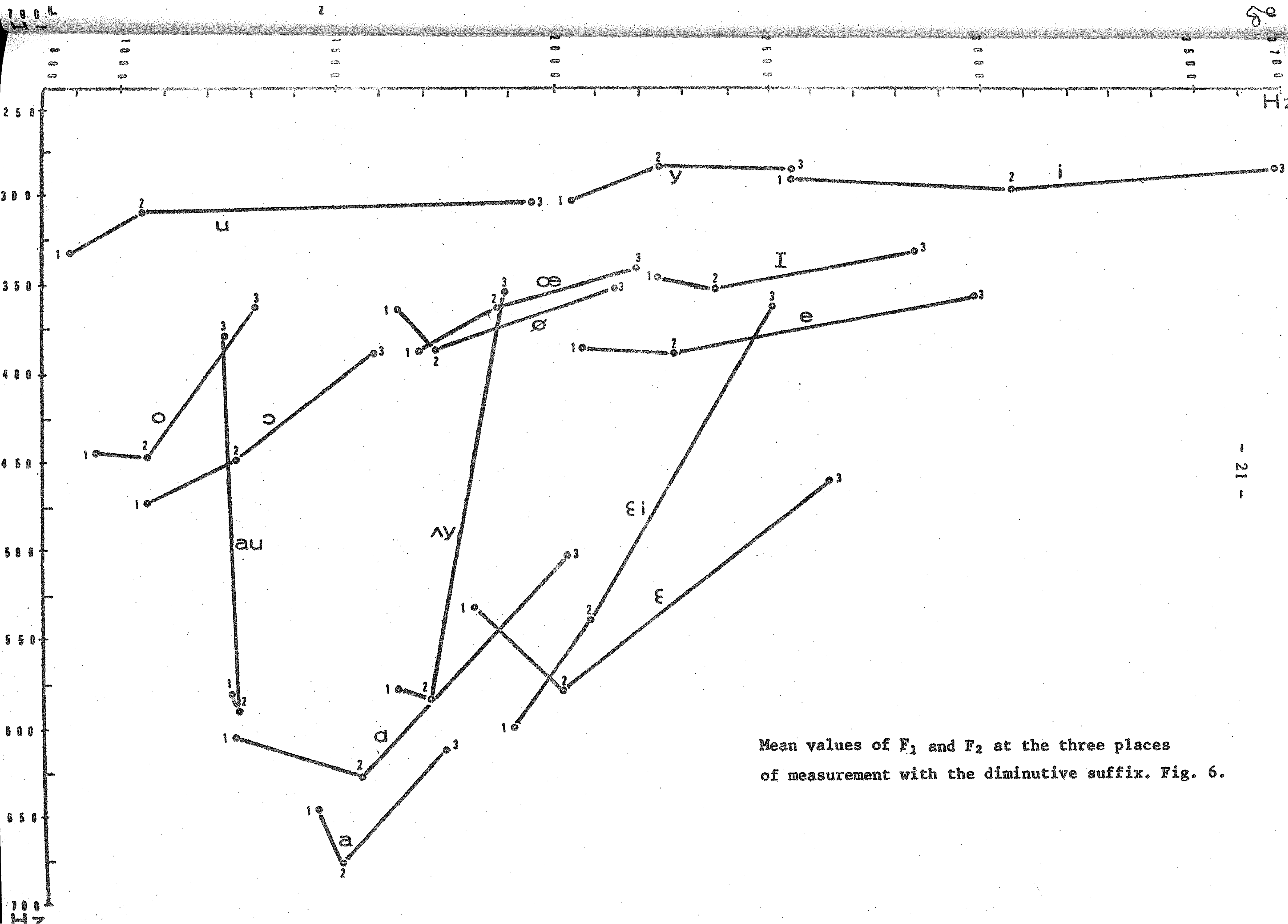


Mean values of the basic frequency at the three places of measurement.

Fig. 4.



Mean values of F_1 and F_2 at the three places of measurement without the diminutive suffix.
Fig. 5.



Mean values of F_1 and F_2 at the three places of measurement with the diminutive suffix. Fig. 6.