TEMPORAL ORGANIZATION AND PERCEPTION OF VOWEL-CONSONANT SEQUENCES IN CENTRAL BAVARIAN[*]

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The phonological description of Central Bavarian sound
structure faces a central problem, namely the analysis of
stressed vowel-consonant sequences, According to the litera-
ture these sequences are of two kinds: A long vowel is
followed by a lenis, weak or short consonant, while a short
vowel is followed by a fortis, strong or long consonant.
The contrast between the two sequences is illustrated by a
word pair like [ke:gal] (name of a hill) and [kekal] (roast
chicken).

Although no phonetic data are provided in the literature,
the following four features are postulated as the one dis-
tinctive feature of both segments:

    (1) Weak of strong accent ("schwach bzw. stark
        geschnittener Akzent", Pfalz 1913 following Sievers
        1881).

    (2) Offglide ("Abglitt", Gladiator 1971 following Pilch
        1964).

    (3) Force of articulation or intensity of the consonant
        (Koekkoek 1955, Keller 1961). This opposition is
        labelled Fortis-Lenis.

    (4) Length of the consonant (Kufner 1956).

I shall propose here that also the Central Bavarian
vowel-consonant sequences represent a case of temporal organ-
ization of a vowel and the following consonant, which is
called complementary length or mutual complementation of

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vowel and consonant (Lehiste 1970) and which is found in other germanic languages, too (e.g. Standard Central Swedish).

In view of the lack of phonetic measurements, I commenced an investigation of Central Bavarian vowel-consonant sequences on two levels of the speech communication process. Firstly, an acoustical analysis and description of the vowel and the consonant of such sequences was made. Secondly, the perception of minimally contrasting pairs was studied using natural stimuli in which several acoustical features of the vowel and the consonant were altered.

In this report I shall first give the durations of both segments and some conclusions I have drawn regarding the temporal organization of the sequences in two word pairs. I shall then give an account of the perception tests where vowel and consonant durations were altered.

Temporal organization of vowel-consonant sequences

Segment durations of vowels and consonants were measured in meaningful, bisyllabic words which consists of a /CVC/-root and the suffix /al/ denoting the diminutive. The two test pairs, the first of which shows the minimal contrast in the vowel-consonant sequences, are the following:

<div align="center">

/CVCal/

</div>

V:C		VC	
[ke:gal]	(name of a hill)	[kekal]	(roast chicken)
[pi:bal]	(chicken)	[pupal]	(little doll)

The initial consonant is a voiceless, non-aspirated stop, either /k/ or /p/. The manifestation of the postvocalic stop varies. Following a short vowel it is voiceless and non-aspirated. Following a long vowel, however, it may be a voiced stop or even a voiced fricative. This variation lies behind the phonological dispute.

The absolute durations of the segments were forced to vary considerably in order to study the temporal organization of

the vowel and the consonant under widely varying conditions. To achieve this, the test words were all placed in five different prosodic patterns. All were statements:

(1) The testword produced alone:

E   emphatic
N   neutral with normal tempo
F   neutral with fast tempo

(2) The test word placed in a sentence:

S_m test word in medial position, answer to the question: "What have you seen?": /i hap s___ gseŋ/ (I have seen the ___).

S_i test word in initial position, carries contrastive stress: /s ___ tat i meŋ/ (It's the ___ I would like to have).

The data on segment durations reported here pertain to speaker 2. He is 45 years old, a carpenter by profession and lives in the village of Polling near Weilheim/Obb. (about 30 miles south of Munich). The measurements of the other two informants show a similar picture.

Figure 1 gives the segment durations of the vowels and the consonants of the four test words in the five prosodic patterns in msec. Not only the long and short vowels, but also the consonant following them show clear differences of duration. It is therefore justified to talk of long and short consonants in Central Bavarian.

If the absolute differences of duration between long and short vowels and consonants within the pairs are compared (Figure 2), it turns out that the difference of segment duration between the consonants in all the prosodic patterns is considerably larger than that between the long and short vowels. This may explain the findings on vowel ratios in Bavarian reported by Zwirner (1961) and therefore is likely to weaken one important point in the argumentation of Gladiator (1971).

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The proportion of each segment in the total duration of the
vowel-consonant sequence may be expressed by calculating
the vowel-to-sequence ratio (V/(V+C)x100 %, Figure 3). The
relative segment duration within the sequences does not
remain constant throughout the prosodic patterns, although
its values appear to fall into two classes: It is higher in
those patterns in which the test word is stressed particu-
larly (given special prominence), it is lower in the cases
of more neutral stress. The variation of the vowel-to-
sequence ratio is similar to the variation of vowel duration,
especially in the sequence /VC:/ (cf. Figure 1). This is
because the absolute duration of the consonants varies
little in comparison to that of the vowels.

The same temporal pattern has been found for corresponding
Central Swedish vowel-consonant sequences (Bannert 1972),
calculated on data given by Elert (1964).

Perception of vowel-consonant sequences

As the starting stimuli for the listening tests, one render-
ing each of the following four minimal pairs was used. The
words were produced in isolation by speaker 1:

	V:C		VC:	
C_m=stop	[fe:da]	(feather)	[set:a]	(male cousin)
	[ke:gal]	(name of a hill)	[kek:al]	(roast chicken)
C_m=fricative	[o:fa]	(stove)	[of:a]	(open)
	[vi:sn]	(meadow)	[vis:n]	(to know)

The vowel-consonant sequences of the test words were mani-
pulated manually (using tape cutting and splicing techniques)
and electronically (by means of a segmentator). The main aim
was to change the temporal relations between the two segments.
The part of the tape containing the segment boundary between
the vowel and the consonant was not touched. Ten listeners
were asked to identify the stimuli either as the one or the
other member of the four minimal pairs.

Here I shall give the identification scores of the listeners
to three manipulations:

(1) Shortening of the initial long vowel in [o:fa] (Figure 4).
(2) Shortening of the long consonants (including the elimi-
    nation of the explosion of both stops). The duration of
    stops was decreased by cutting out portions of the
    silent interval of occlusion (Figure 5).
(3) Lengthening of the short stops in [fe:da] and [ke:gal].
    The periodicity of the occlusion had been gated out
    previously.

All these changes of the duration of only one segment at a
time led to the identification of a given vowel-consonant
sequence as its counterpart (cf. Fliflet 1961, Heike 1969,
Fischer-Jørgensen and Jørgensen 1969). This also happened
when the relatively strong explosion of the considerably
shortened, originally long stops was eliminated. This explo-
sion may be considered part of the manifestation of the
feature fortis.

If the results of the identification test are considered
together with the temporal regularities observed in the
vowel and the consonant, two things become evident:

(1) The auditive Fortis-Lenis contrast of the postvocalic
    consonant is always combined with clearly different
    durations of this segment (and the feature of voicing,
    cf. Bannert 1972, 1974, and forthcoming). This contrast
    is likely to be a consequence of the segment durations
    (cf. Ladefoged 1971).
(2) Although the contact between the vowel and the consonant
    was retained unaltered, each kind of sequence could be
    turned into its respective counterpart. This total
    reversal of identification was obtained by varying
    segment duration alone and, as a consequence, the
    temporal relations between the vowel and the consonant.

Therefore, in consideration of these preliminary phonetic
data it seems likely that the Central Bavarian vowel-

consonant sequences in fact constitute a case of temporally
distinctive organization of phonological segments. Hence the
phonological analysis should take this fact in to account and
handle the phenomenon of complementary length in Central
Bavarian by applying the temporal distinctive feature of
QUANTITY (cf. Lehiste 1970, Bannert 1973).

The phonological solution suggested here will lead to an
analysis of the segmental phonological units (phonemes) of
Central Bavarian, especially the stops, which differs from
those hitherto found in the literature (Bannert forthcoming).

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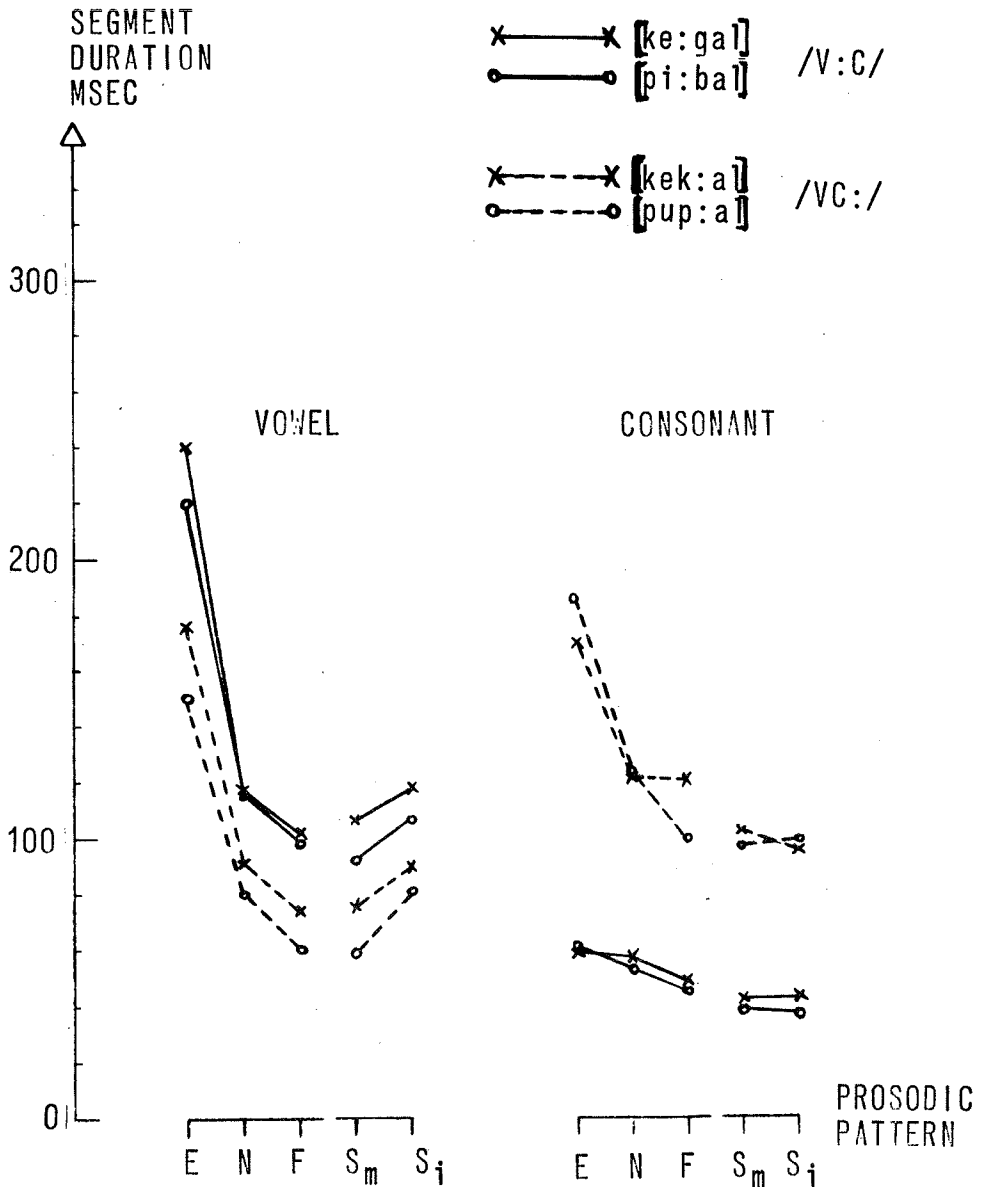   500-518

Figure 1. Durations of the vowels (left) and the consonants (right) in the four test words in msec.
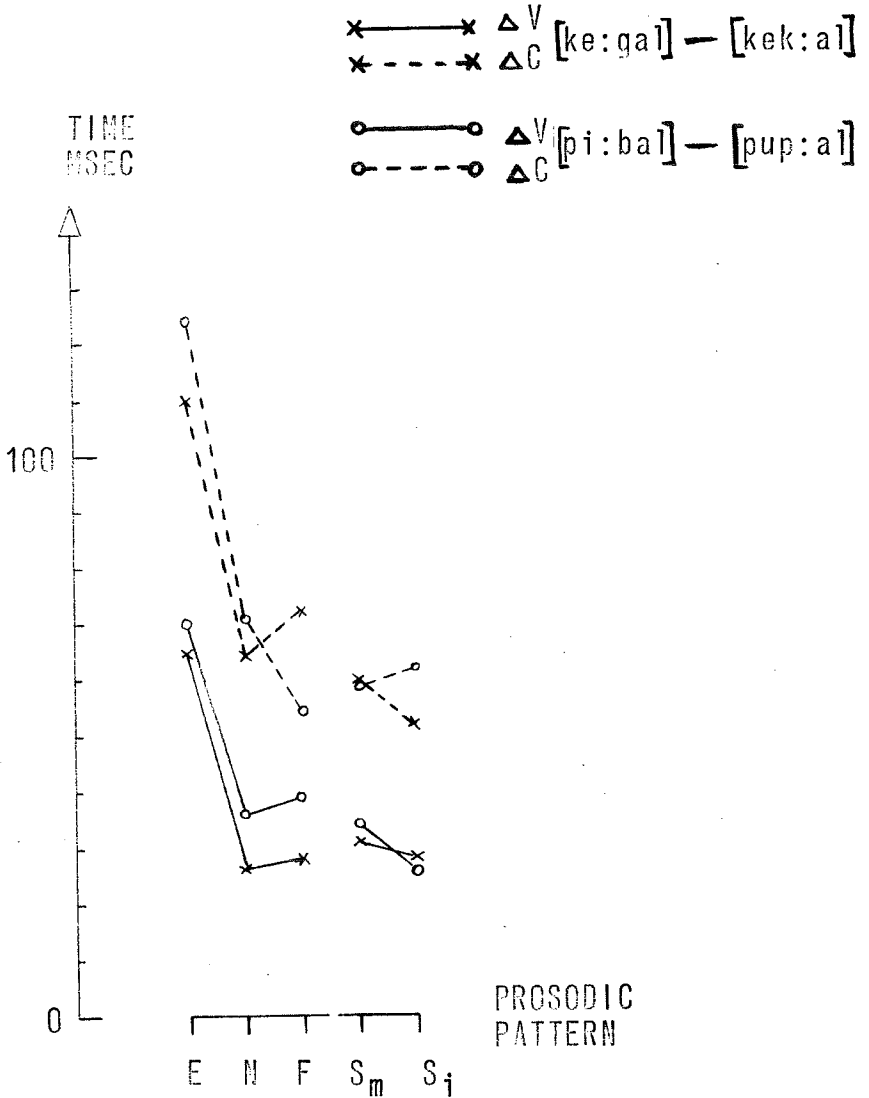
Prosodic patterns see text.

Figure 2. Difference of durations (msec) between the long and the corresponding short segments of the two word pairs.
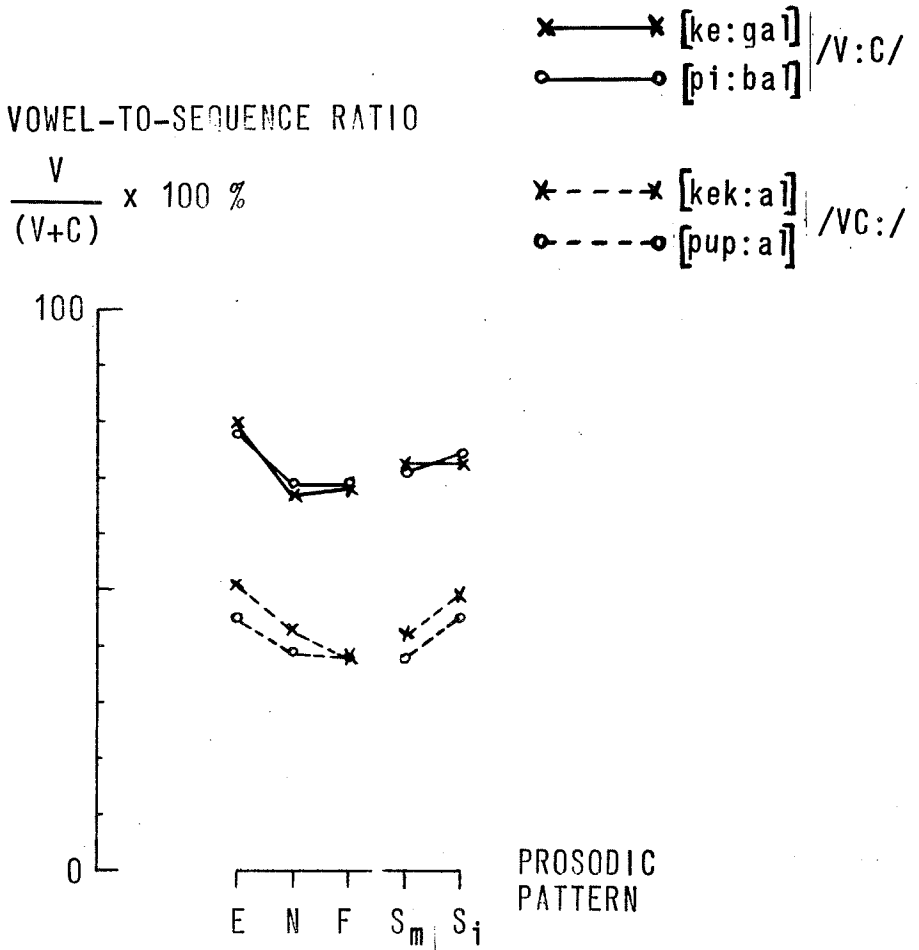
VOWEL-TO-SEQUENCE RATIO

$$\frac{V}{(V+C)} \times 100 \%$$

Figure 3. Vowel durations in relation to the duration of the entire vowel-consonant sequence, expressed by the vowel-to-sequence ratio in %.
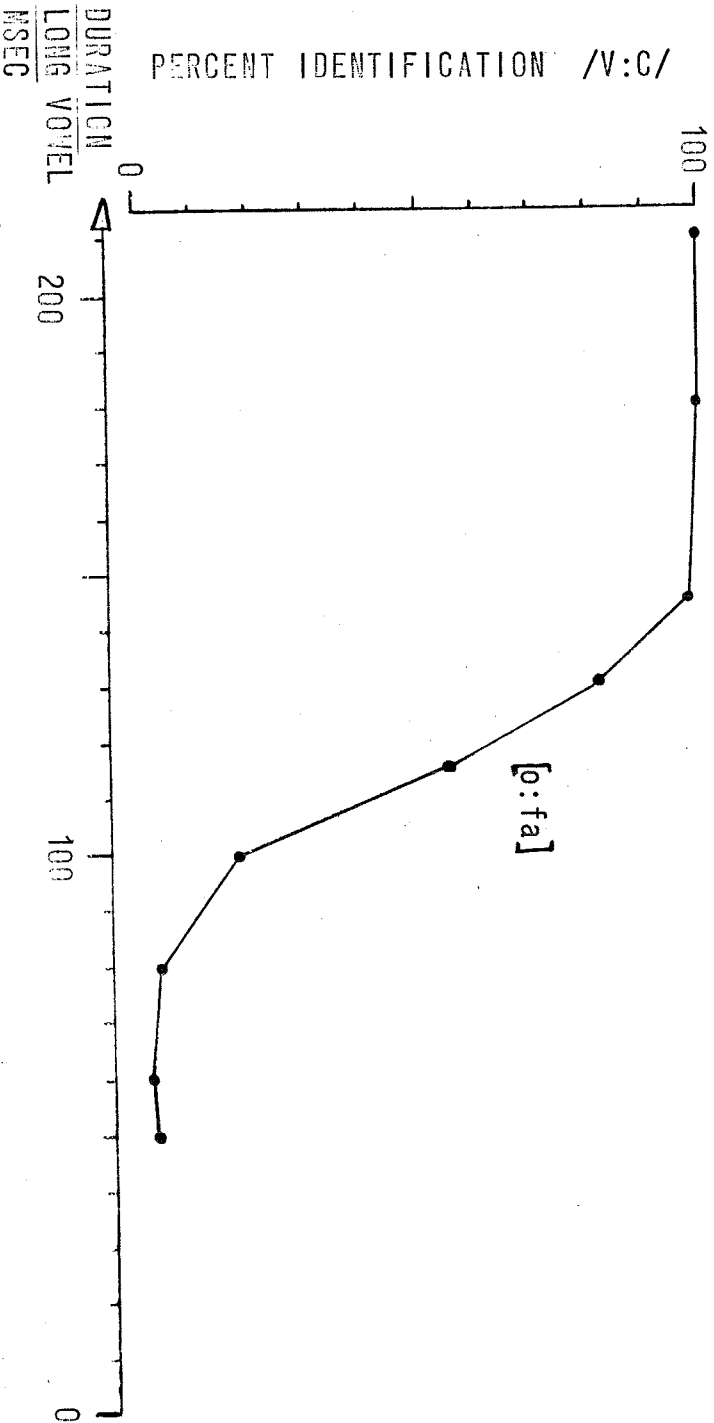
PERCENT IDENTIFICATION /V:C/

[o:fa]

DURATION LONG VOWEL MSEC

Figure 4. Identification of the word [o:fa] when the long initial vowel is shortened. Ten listeners responded to each stimulus ten times each; a total of 100 responses.
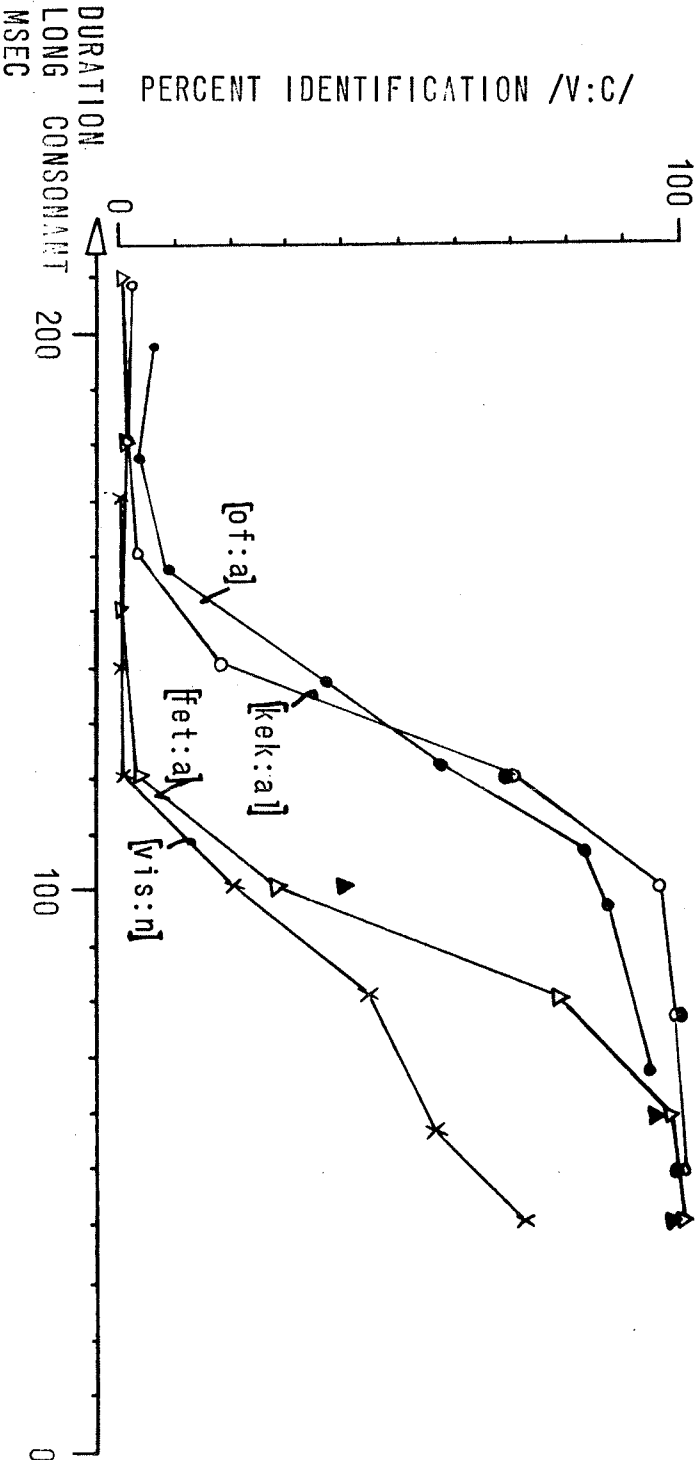
Figure 5. Identification of the four test words with long consonants when their durations are decreased. Explosion eliminated in [fet:a] (▲) and [kek:a]] (●).
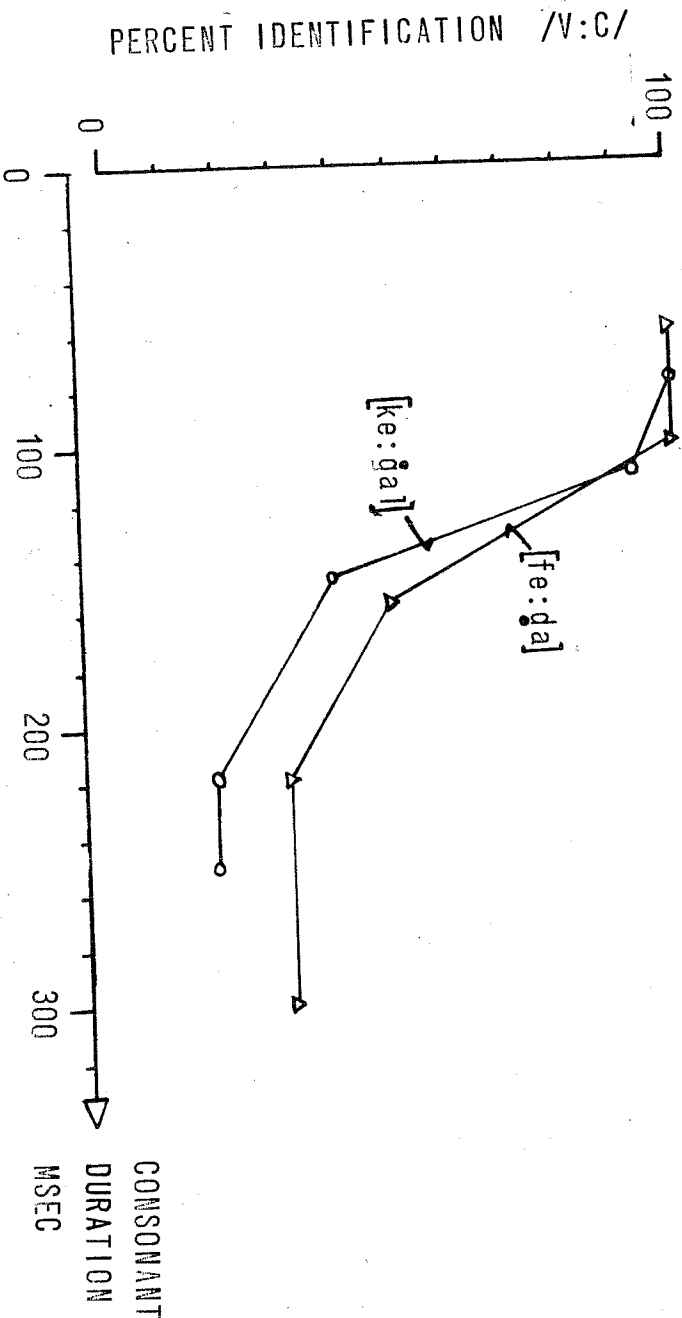
Figure 6. Identification of the words [fe:da] and [ke:ga] when the short stops are lengthened. The periodicity of the occlusion had been gated out previously.