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SELECTED PROBLEMS IN THE TONAL MANIFESTATION OF WORDS CONTAINING ASSIMILATED OR ELIDED SCHWA

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69 words recorded in carrier sentences by four speakers are the basis for an acoustic analysis of fundamental frequency patterns under various kinds of schwa assimilation, instigated by a previous observation of "delayed" Fo peaks in words with assimilated schwa. It turns out that the tonal reduction or assimilation - if and when it occurs - is a function of the durational reduction involved in assimilation of schwa rather than a characteristic of schwa syllables and assimilation as such. The durational modifications involved in schwa assimilation are established.

I. INTRODUCTION

In my first analysis of Advanced Standard Danish intonation (Thorsen, 1978) I observed that words with a syllabic consonant in the first post-tonic (arisen through assimilation of schwa) deviated tonally from words with a vowel in the same position. The normal stress group pattern has a (relatively) low stressed syllable followed by a rapid rise or jump up to the first post-tonic, which constitutes the peak of the pattern; post-tonics after the first one describe a more or less steep fall. In words with assimilated schwa in the post-tonic, the fundamental frequency (Fo) maximum did not occur until the second post-tonic syllable, though the first one clearly rose above the low stressed syllable. I speculated that this might be an expression of a (partial) tonal assimilation accompanying the assimilation of schwa. However, from Rischel (1970) it would seem that tonal assimilation of schwa-syllables is at least not an obligatory corollary of segmental schwa-assimilation. Rischel made a study of how syllable number is distinguished acoustically in words of the type *hårde-hårdere* [ˈhɒ·ʌ ˈhɒ·ʌʌ] and *faldne-faldende* [ˈfalnə ˈfallne] 'hard (pl.)-harder' and 'fallen (pl.)-falling'. His informants did not behave uniformly, but for some of them he reports that, apart from some not quite stable durational differences in the consonants, the peak in the rising-falling tonal pattern occurred much earlier, relatively to the end of the word, in tri- than in disyllabic words. It is tempting to reformulate this finding and say that, in the material in question, the peak of the tonal pattern occurred in the first post-tonic syllable: hence it would occur very near the end of the word in words with only one post-tonic, whereas there must be a subsequent fall in words with several post-tonics. This amounts to saying that segmental assimilation of schwa in the first post-tonic syllable was not accompanied by tonal assimilation, at least not to the extent that the Fo peak was delayed until the end of the word, i.e. till the second post-tonic. (The subjects in Rischel's study spoke a rather conservative norm, and the recordings represented a high level of distinctness; Rischel, personal communication.)

II. DELIMITATION OF THE SUBJECT

Brink and Lund (1975), henceforth BL, contains a thorough treatment of schwa assimilation, its phonetic and commutative consequences, in particular the durational aspects, which have been subjected to empirical, instrumental investigations, though on a rather modest scale (§ 32). BL are less explicit and also somewhat contradictory about tonal relations. On p. 194-195 they state that the sound which replaces schwa is clearly syllabic, not through lengthening of the neighbouring sound, but due to intonation [emphasis supplied, NT]: the difference between *faldne* [ˈfalnə] and *faldende* [ˈfallne][1], 'fallen (pl.)' and 'falling', is tonal, the former having two pitches, the latter three pitches (cf. Rischel's (1970) results above). However, on p. 197 we are told that "pure" schwa assimilation [see further below] leads to extra length in e.g. *luen og* 'the flame and' which will thus still contrast with *luner* 'shelter (vb.)': [ˈlu·unʌ - ˈlu·nʌ], although the second [u] in *luen og* by interval reduction loses its independent, syllable-constituting pitch [emphasis supplied, NT].

(1) The generality of the "delayed" Fo peaks mentioned in the introduction should be established. In other words: will syllables with assimilated schwa behave differently tonally from syllables with unassimilated schwa? Or do schwa-syllables as such deviate? And how does a succession of two schwa syllables behave?

BL (p. 198ff) distinguish "pure" schwa assimilations, where the syllabic sound developed from schwa is fully as long as the original schwa, from cases where a certain durational reduction of the word is entailed. Pure assimilation is found in two instances: when schwa assimilates to a preceding vowel [which is always long since schwa does not occur after short vowels, NT] (*luen* /lu·ən/ [ˈlu·un] 'the flame'), and when schwa assimilates to a preceding voiced consonant after a short vowel (*finde* /fenə/ [ˈfenn̩] 'to find'). In all other instances the duration of the syllabic consonant is reduced compared with the total duration of unassimilated consonant and schwa, although it is longer than ordinary (i.e. unassimilated) corresponding consonants. Nonetheless, a durational distinction between syllabic consonants from /Cə/ versus /əC/ is still maintained in distinct speech, the former being less reduced than the latter. - The examples offered for this statement are *pæne, syle, hjerne, hele* [ˈb̥ʰɛ·n̩ ˈsy·l̩ ˈjæʌ̯n̩ ˈhe·l̩] 'nice, awls, brain, whole' versus *handel, cykel, hætten* etc. [ˈhanˀl̩ ˈsyg̊l̩ ˈhɛd̥n̩] 'trade, bicycle, the hood', the latter still being clearly longer than [n] and [l] in e.g. *verdner, cykler* etc. [ˈvæʌ̯d̥nʌ ˈsyg̊lʌ] 'worlds, bicycles'. The generality of a durational distinction between /Cə/ and /əC/ seems to be modified, though, by the passage on p. 199 where it says that *visne* and *cykle* '(to) wither' and '(to) bicycle' may, but only rarely, have a longer syllabic consonant than *vissen* and *cykel* 'withered' and 'bicycle'. However, these particular types are distinguished through a curious lengthening of the preceding consonant [emphasis supplied, NT] in the /VCCə/ structure, i.e. [ˈves·n̩ ˈsyg̊·l̩] versus [ˈvesn̩ ˈsyg̊l̩]. Lengthening of the preceding consonant takes place in groups of two consonants after a short vowel when the first consonant has less sonority[2] than the syllabic one, and the authors reason that this lengthening in the first consonant might favour a shortening of the second, syllabic one. But they also declare durational differences to be rare in the syllabic consonant in *sultne, rustne* [ˈsuld̥n̩ ˈʁɔsd̥n̩] (?) 'hungry (pl.), rusty (pl.)' (where there is no lengthening of the preceding consonant) versus *sulten, rusten* [ˈsuld̥n̩ ˈʁɔsd̥n̩] 'hungry, rusty'.

/rə ər rər/ may all fuse in [ʌ], but this is not a case of schwa assimilation (p. 212-213): /ə/ becomes [ʌ] in the environment of /r/ which is then vocalized. This process shares a feature with schwa assimilation, however: the curious lengthening of the preceding consonant as in *hamre, blafre, pebre, kvidre* [ˈhɑm·ʌ ˈb̥laf·ʌ ˈb̥ʰew·ʌ ˈg̊ʰvið·ʌ] '(to) hammer, (to) flicker, (to) pepper, (to) twitter'. In the chapter on diachronic shortening of long voiced consonant before a voiced consonant (§ 49) it is stated explicitly (p. 367) that this lengthening before /rə(r)/ is not a relict of an older state of things but a true compensatory lengthening, since the lengthening is obligatory when /r/ is vocalized, but only optional when [ʁ] is pronounced. [To my mind, a classification as "compensatory" is dubious if it ever occurs when [ʁ] is pronounced, or at least it cannot be viewed as a compensation in the on-going speech production process.]

I have previously argued (e.g. in Thorsen 1980 and 1982) that syllables and segments do not carry specific Fo movements, but they float on a more or less invariable Fo wave. In other words, the syllables and segments are aligned with the Fo patterns, not vice versa, a state of affairs which leads naturally to a condition where the course of Fo in syllables consisting, say, of short vowels surrounded by unvoiced consonants can be viewed as a truncation of the more extensive movements we get with syllables consisting of long vowels and voiced consonants. There is ample evidence that this is indeed the case when the duration of words and syllables is not interfered with, e.g. through compensatory lengthening, but

(2) those instances where schwa assimilation is said to lengthen a preceding consonant, as well as lengthening due to /r/-vocalization call for empirical investigation. In particular, the tonal consequences, if any, of the durational variation should be established.

To further illustrate the relation between segmental structure and Fo in the stress group I included in the material two sets of words whose behaviour is specifically mentioned by BL (p. 195-197) and which are otherwise quite uncontroversial:

(3) "Pure" assimilation of schwa to a preceding voiced consonant after a short vowel, like *finde* '(to) find' leads to a particularly long syllabic consonant, and clearly longer than after long vowel as in e.g. *bene (af)* '(to) beat it'. Furthermore, the first part of this extra long syllabic consonant has been formed before the second pitch is initiated. - [I would rephrase this: the Fo peak is later relative to the start of the consonant in syllabic consonants after short than after long vowels.]

(4) Elision of word final schwa after an unvoiced consonant does not result in any compensatory lengthening of the unvoiced consonant, and accordingly *skaffe, skaf; stikke, stik* [ˈsg̊ɑf ˈsd̥eg̊] '(to) procure, procure (imp.); '(to) prick, prick (imp.)' no longer contrast due to this syncope of schwa, as it must be termed. [However, we might get a compensatory lengthening of the preceding vowel and/or a compensatory tonal movement (even if partial), in other words a compression of the low + high Fo movement characteristic of a sequence of stressed plus unstressed syllable <u>into</u> the stressed vowel of such words.]

III. PROCEDURES

A. MATERIAL

Transcriptions and translations are given in Appendix I, which also reflects the different likelihood of schwa-elision in the material.

(1a) <u>syllabic consonant versus [ə]</u>

After long vowel	*males banes mades* vs. *mases*
After short vowel	*tælles kendes loddes* vs. *tættes plottes*

(1b) two successive /ə/-syllables with assimilated and pronounced schwa, respectively

tykkelse tykkelsen
Tykkesen tykkeste
blottelse blottelsen
Ottesen flotteste

(1c) [ə] versus [i] — *bille* vs. *billig*; *flitte* — *flittig*

Kort vokal

(2) /VCCə/ versus /VCəC/ where the first consonant is a stop, a fricative, a nasal, a lateral, or a semivowel

The second consonant is /l/

pukle	vs.	*pukkel*
gafle		*gaffel*
gamle		*gammel*
padle		*saddel*

According to BL, the last pair should not exhibit the same durational pattern as the other three, since the syllabic consonant in *padle* will not be the more sonorous of the two, and furthermore the syllabic consonant in *saddel* is [ð] rather than [l].

The second consonant is /n/

mugne	vs.	*muggen*
visne		*vissen*
bulne		*bullen*
vidne		*viden*
kærne		*kærren*

bulne-bullen and *vidne-viden* should not, according to BL, exhibit the same pattern as the two uppermost pairs, since the syllabic consonant in *bulne* and *vidne* will not be the more sonorous of the two, and furthermore the syllabic consonant in *bullen* and *viden* will not be the nasal but rather [l] and [ð]. *kærne-kærren* deviates in that phonetically the second syllable in *kærren* is carried by a vocalic sound, i.e. [ə] assimilates to the non-syllabic part of the preceding diphthong, [ˈg̊ʰæʌ̯ʌn].

The second consonant is /r/

klatre	vs.	*klatter*
ofre		*offer*
tømre		*tømmer*
baldre		*kalder*
bladre		*kladder*

(3) Syllabic consonant after long versus short vowel

bane	vs.	*bande*
kane		*kande*
kugle		*kulde*
skele		*skille*

and for comparison with the four pairs above:

Lang vokal /V·Cə/ versus /V·əC/ — *lune* vs. *lugen*

(4) Complete schwa-elision after unvoiced obstruent versus disyllables versus monosyllables[3]

After long vowel	*skabe*	vs.	*skaber*
	gyse		*gyser*
After short vowel	*stoppe*		*stopper, stop*
	passe		*passer, pas*

The words were embedded in short declarative sentences, like *Barnet skal mades med skeen. Hun elsker den gamle soldat med sablen. Der er flere skabe til pigernes tøj. Han henter en kande til mælken og fløden.* The 69 sentences and their translations are listed in Appendix II. Words that were to be immediately compared occurred in identical position in sentences that were as much alike syntactically and rhythmically as possible. The sentences were randomized and mixed with a material recorded for a different purpose, so that no more than three of the sentences ever occurred in direct succession.

B. SUBJECTS AND TECHNICAL PROCEDURE

Four phoneticians, two males (NRP and JR) and two females (BH and NT (the author)), read the material. NRP, BH and NT speak Advanced Standard Copenhagen, JR speaks a slightly more conservative variant but, as noted in Thorsen (1980, p. 199), JR does not exhibit any qualitative differences from the other subjects as far as stress group patterns are concerned. NRP, JR and BH recorded the material six times each, NT recorded it ten times. Subjects' style of speech can be characterized as conversational but distinct.

The recordings were made with semi-professional equipment (Revox A-77 tape recorder, Sennheiser MD21 microphone and larynx microphone) in a quasi-damped room at the Institute of Phonetics on Agfa PE36 tape at 7½ i.p.s. The tapes were processed by hardware intensity and pitch meters (F-J Electronics) and registered on a mingograph (Elema 800) at a paper speed of 100 mm/s. The signal from the larynx microphone was processed in the pitch meter's hold mode. In combination with adjustment of the zero-line to the lower limit of the subject's voice range and full exploitation of the record space of the mingograph galvanometer, this yields a good solution of the frequency scale, generally allowing for a measuring accuracy of 1 Hz for males and 2 Hz for females.

In unidirectional Fo courses with constant slope only the beginning and end points were measured, according to a procedure outlined in Thorsen (1979, p. 63-66). In more complex Fo courses three to six points were measured, in a manner so that the traces could be accurately reconstructed by smooth interpolation through the measuring points. The distance in time of each measuring point from the first one was measured and so was the duration of each segment, to the extent that reliable segmentation could be made. Fo and time measurements were averaged over the six (ten) recordings by each subject. The average Fo values were converted to semitones (re 100 Hz) and average tracings drawn. No correction was made for intrinsic Fo level differences between vowels.

Standard deviations on the average Fo and duration values are generally small, about 3% to 5% of the mean and very rarely exceeding 10% (they are often smaller for stressed vowels than post-tonic vowels and syllabic consonants), so production stability across different readings is rather good and the figures must be fairly reliable indications of subjects' behaviour.

Slightly stylized Fo tracings of the various words to be compared are depicted in figure 1-4. They will be referred to by subjects' initials and frame number, like NRP-7, JR-14, etc. To complete the picture of the stress group pattern, the succeeding post-tonic (a preposition in the majority of instances) is included. A raised numeral after the signature in the frames indicates the number of items from which the average is calculated, if it deviates from six (or ten, in NT's case).

In a few cases, notably with JR, only one or two periods were registered in the post-tonic vowel(s), i.e. only one measuring point is marked, and accordingly such post-tonics appear as dots in the figure, see e.g. JR-26, and it will generally be self evident which stressed syllable the dot is to be coupled with. When a sonorant consonant could be reliably segmented from the neighbouring vowel(s) it will appear in the tracings either through a discontinuity (due to different intrinsic Fo levels) or with vertical strokes underneath the tracings, see e.g. NRP-15 and NRP-19.

In some instances a subject will produce the same word in two editions: both will be included and the signature will indicate the pronunciations, see e.g. NRP-13. In other cases a subject will consistently produce a word in a manner different from the maximally reduced one I had attempted to elicit, and it will be indicated accordingly in the signature, see e.g. NRP-18.

IV. RESULTS

Note first of all that schwa does not assimilate to its surroundings with equal ease in all phonological contexts. After a single post-vocalic sonorant (like *males*, *kande* etc.) schwa is assimilated almost without exception, and likewise between an obstruent and a sonorant (as in *blottelse*, *gaffel* etc.). Schwa assimilation in the /ˈ-VCCə/ type does not occur as frequently; moreover, the likelihood of such assimilation is far greater when the post-vocalic consonant is a sonorant (like *gamle*) than when it is an obstruent (like *pukle*). The latter condition also holds for [ʁ]-vocalization. Complete schwa-elision after a post-vocalic unvoiced consonant is comparatively rare in the style of speech that this material represents, except maybe after a short vowel plus fricative (like *passe*).

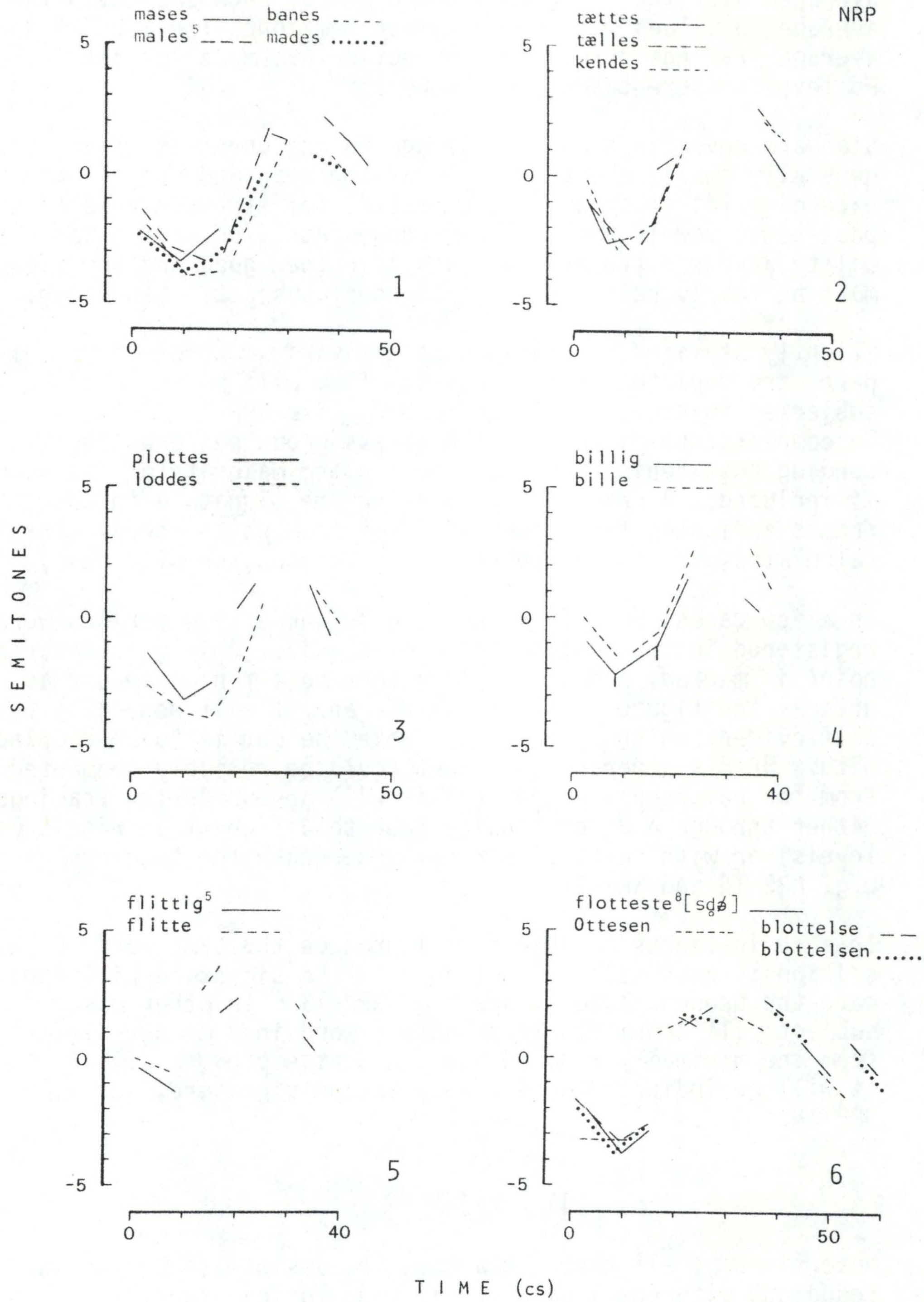
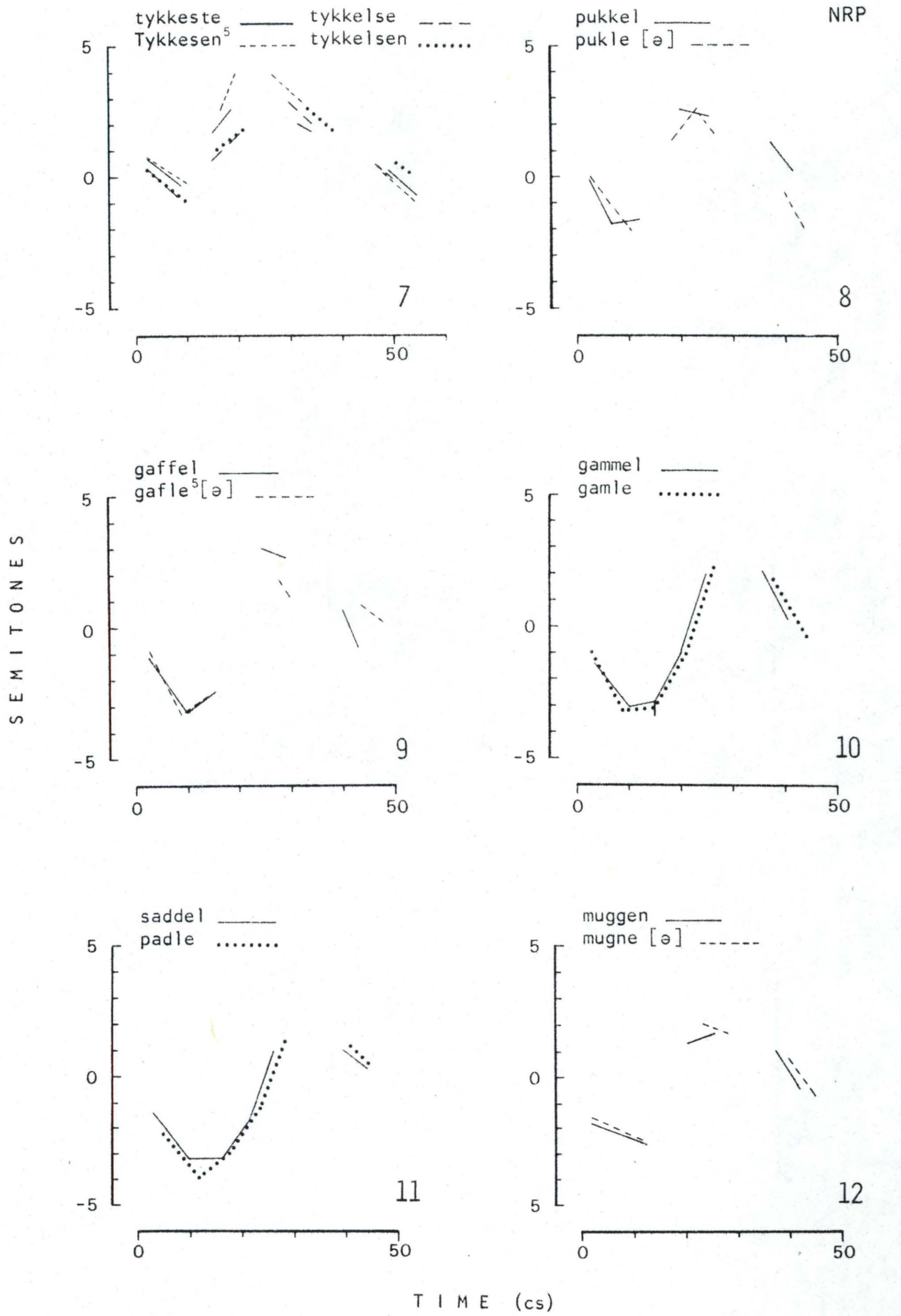


Figure 1

Fundamental frequency tracings (averages) of the test words of the material and the succeeding unstressed word. A raised numeral after the signatures in each frame indicates the number of items behind the average tracing, if it deviates from six. Zero on the logarithmic frequency scale corresponds to 100 Hz. Subject NRP.



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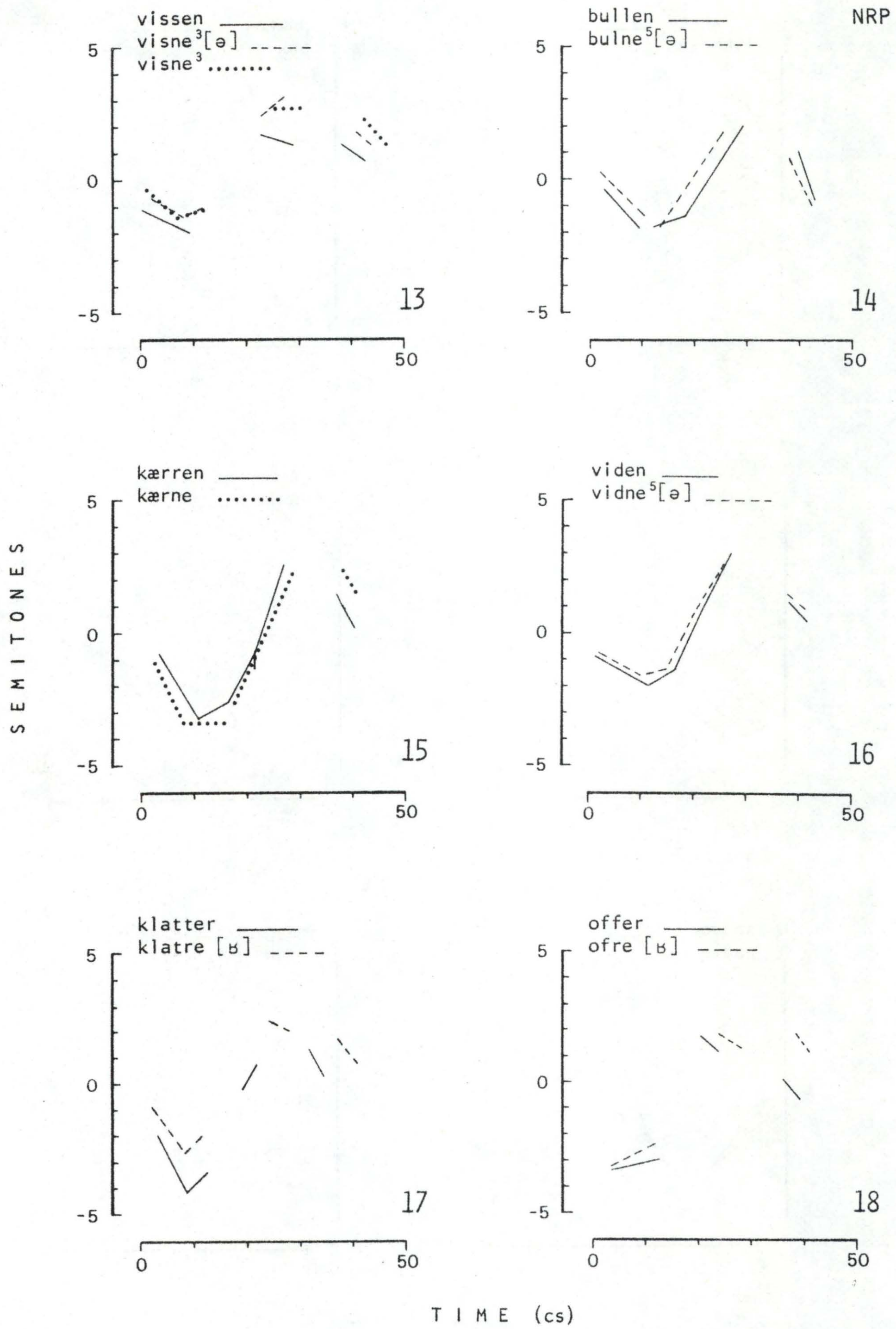

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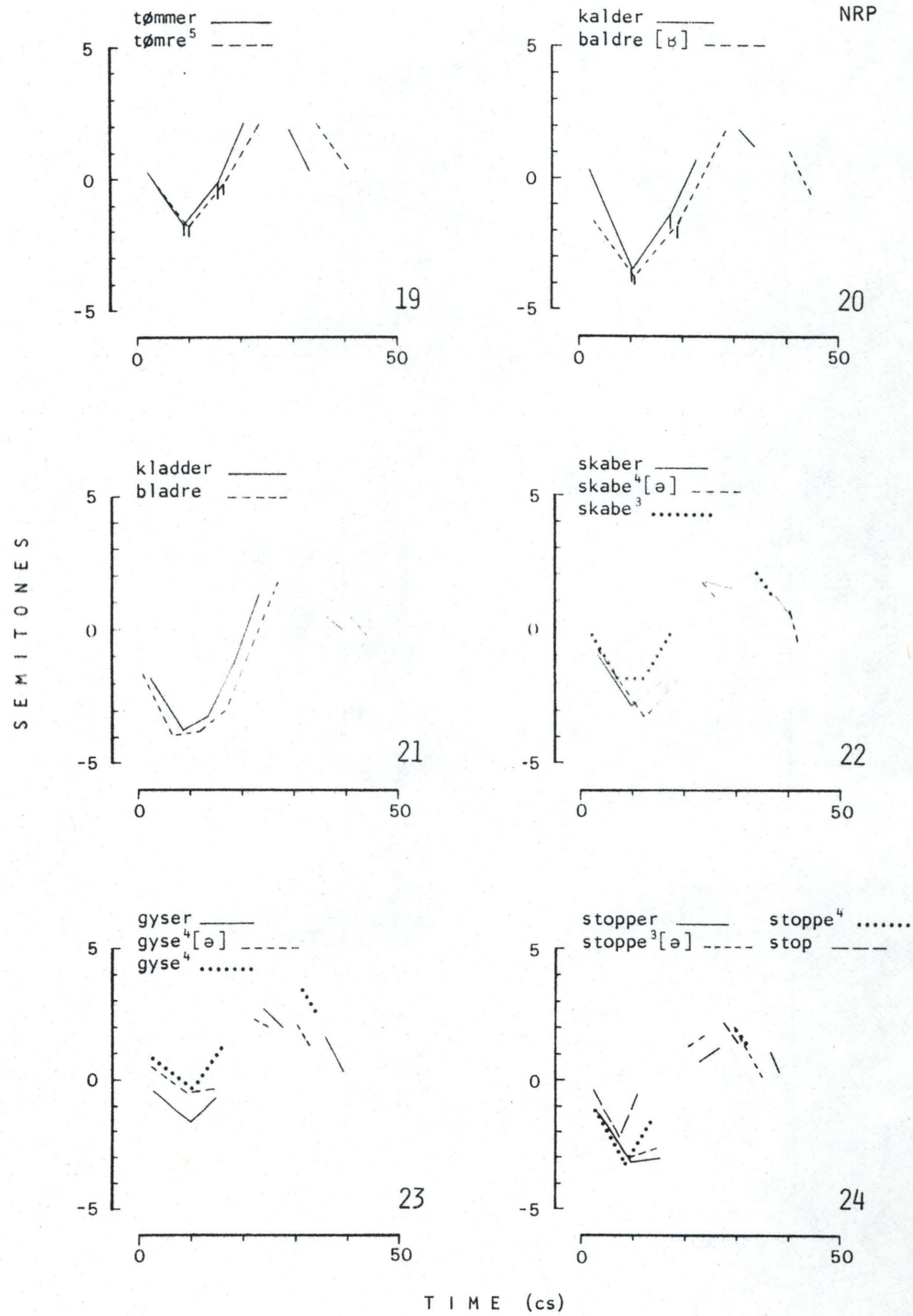

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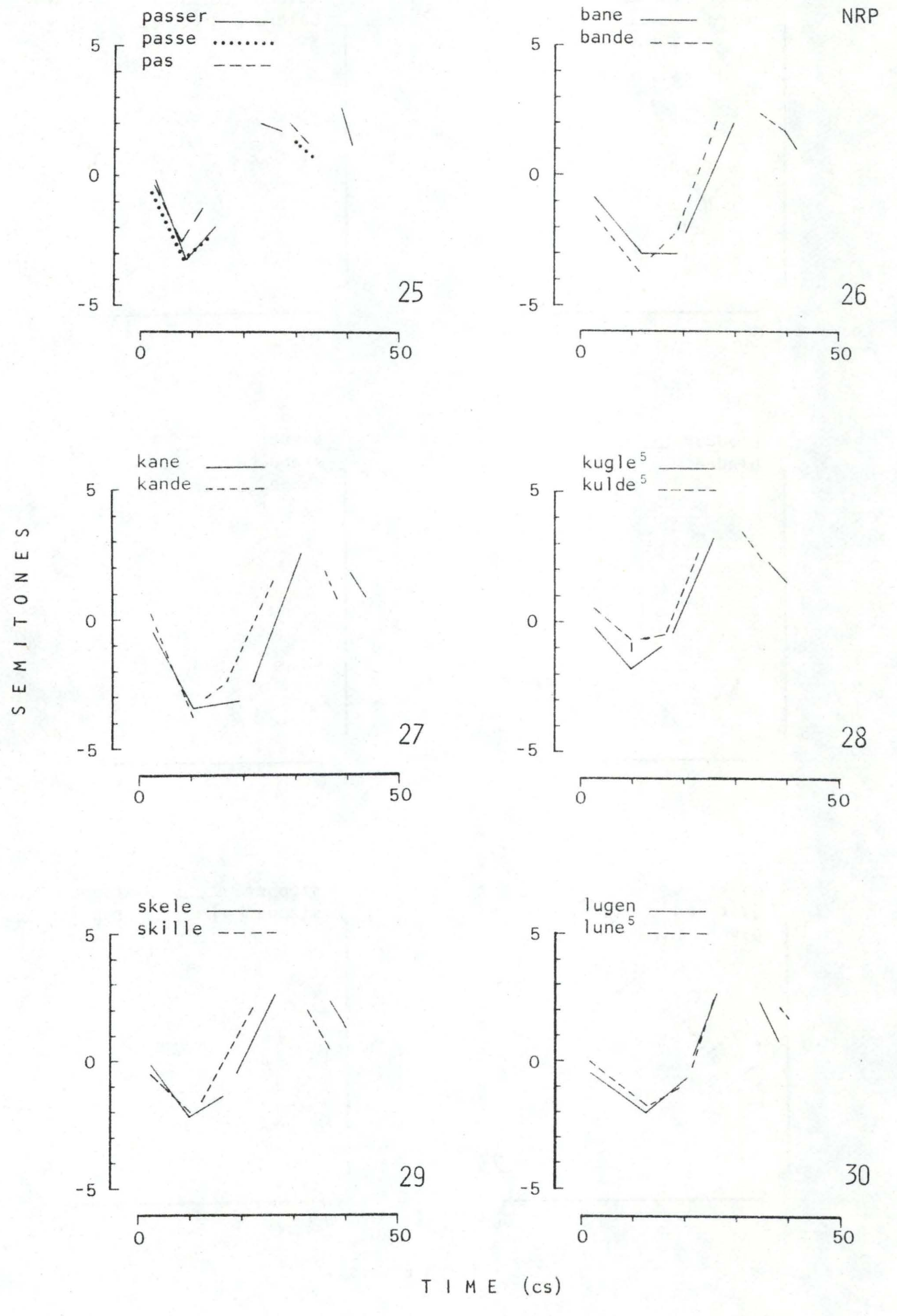

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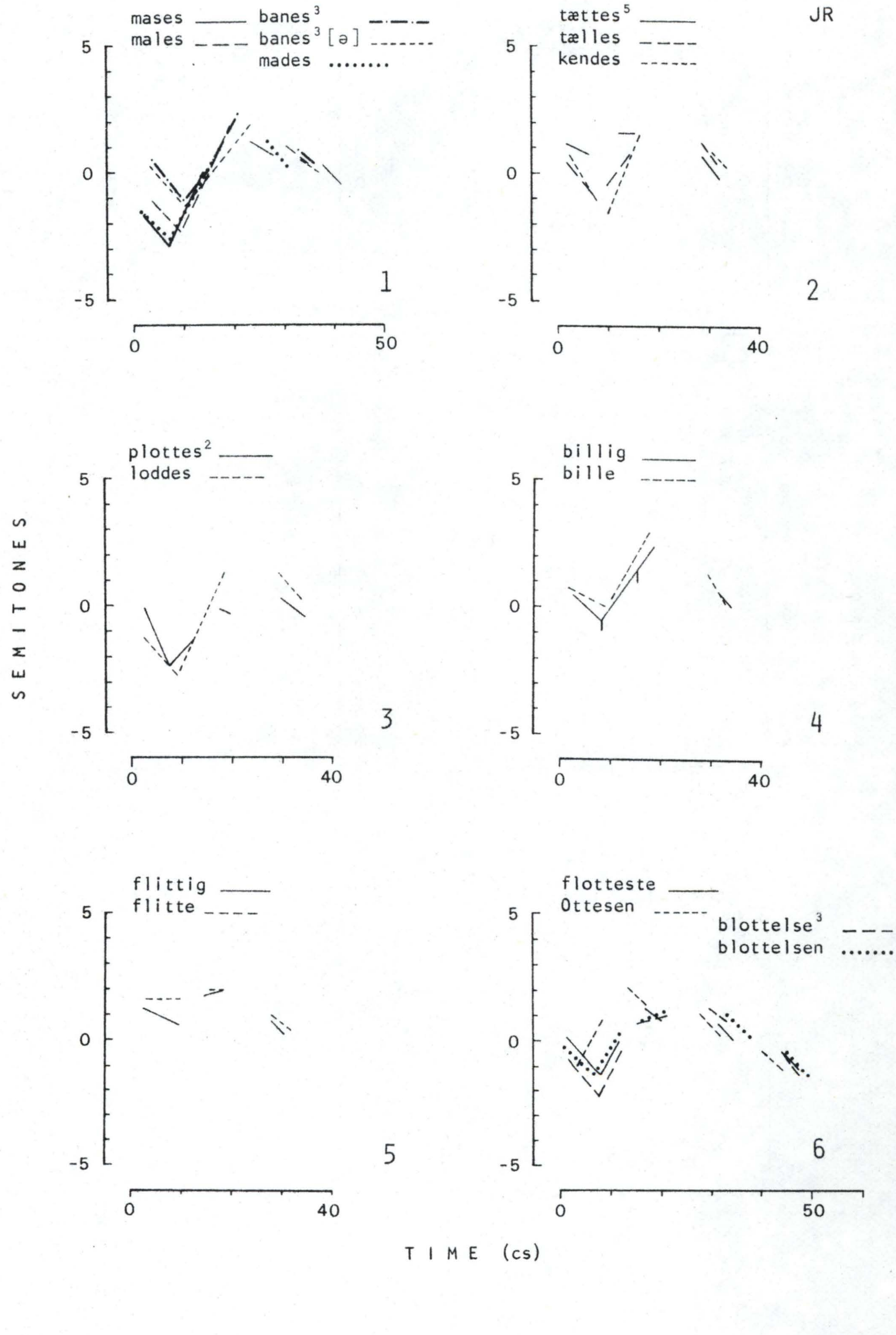
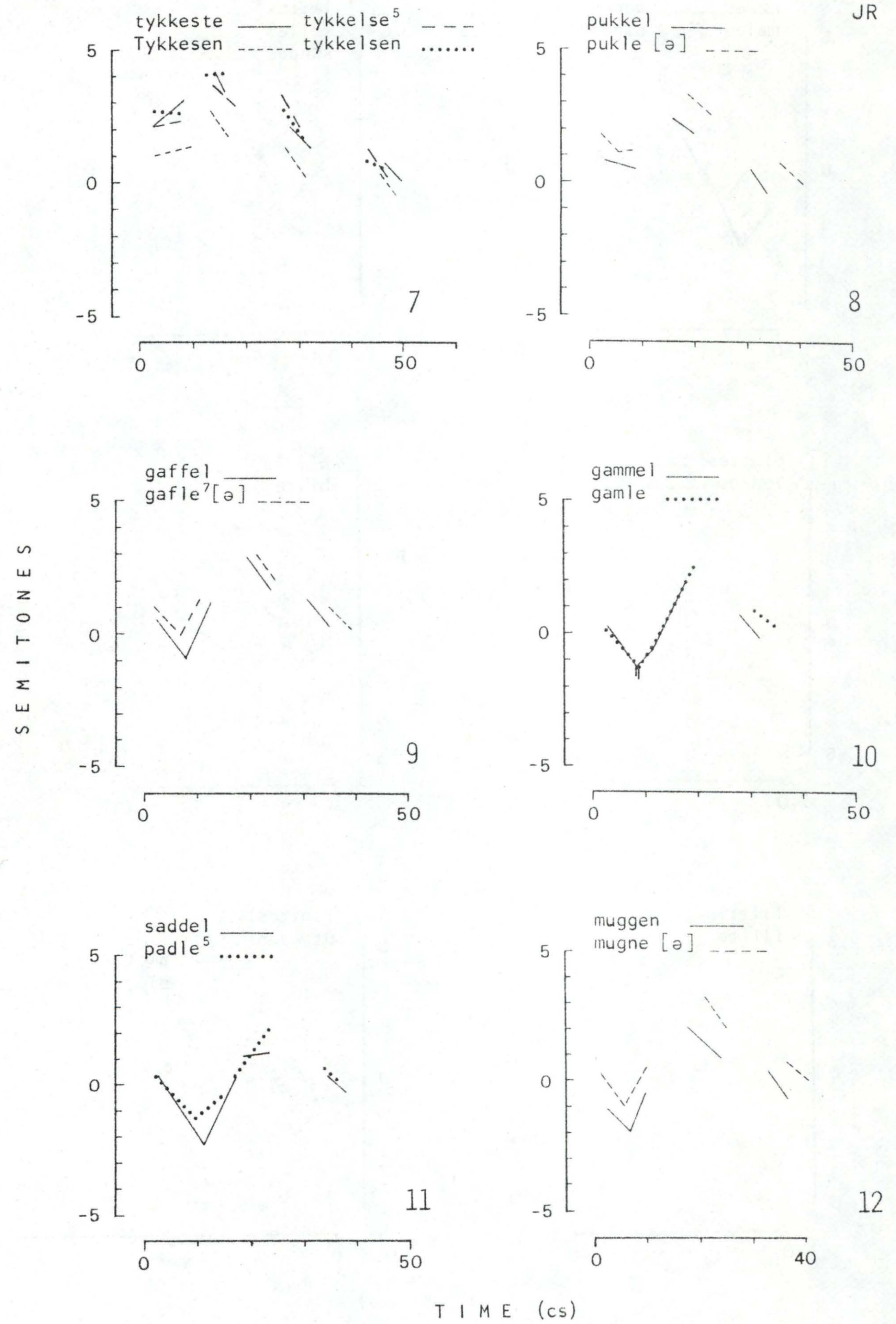


Figure 2

Subject JR. See further legend to figure 1.



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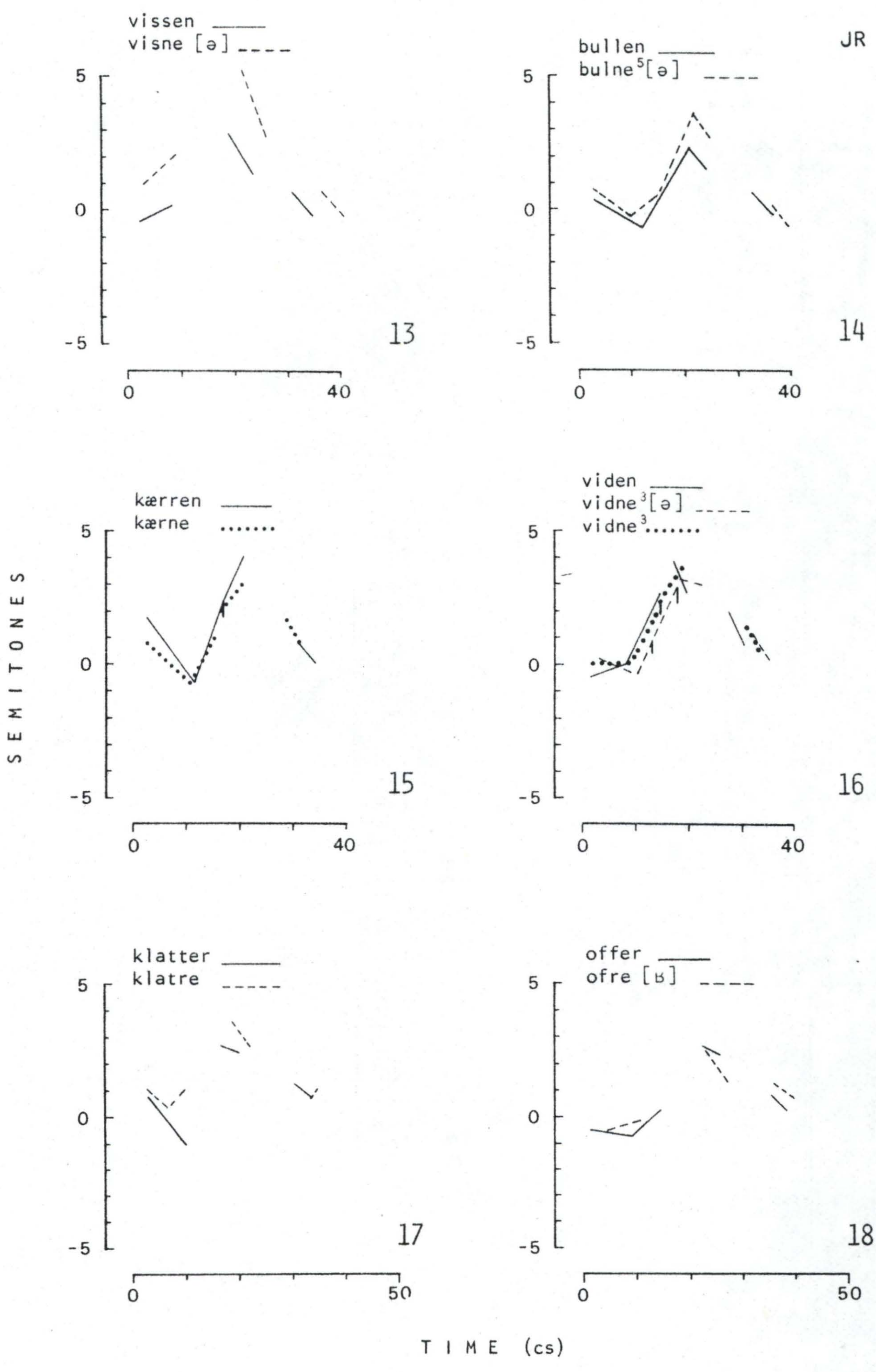

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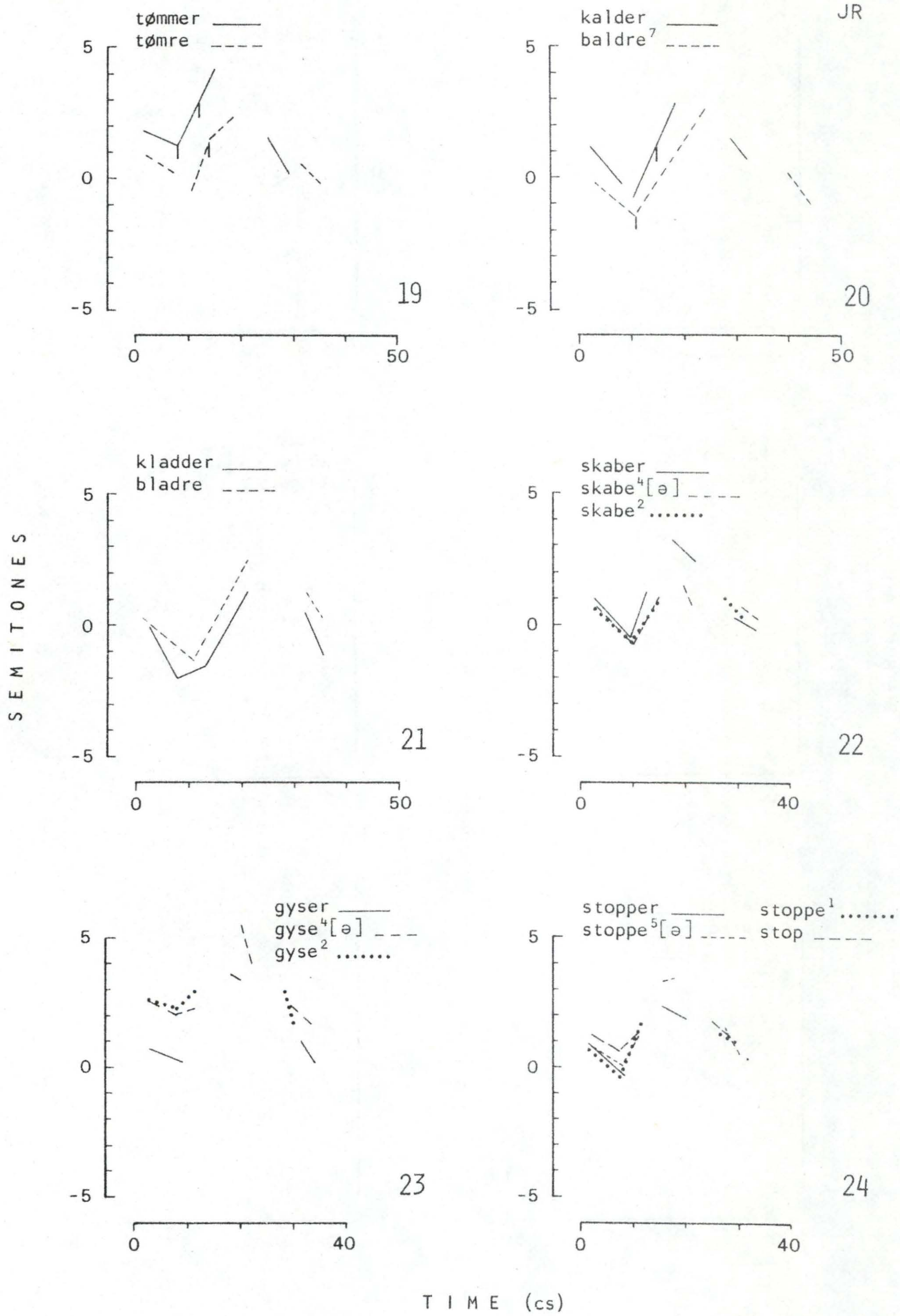

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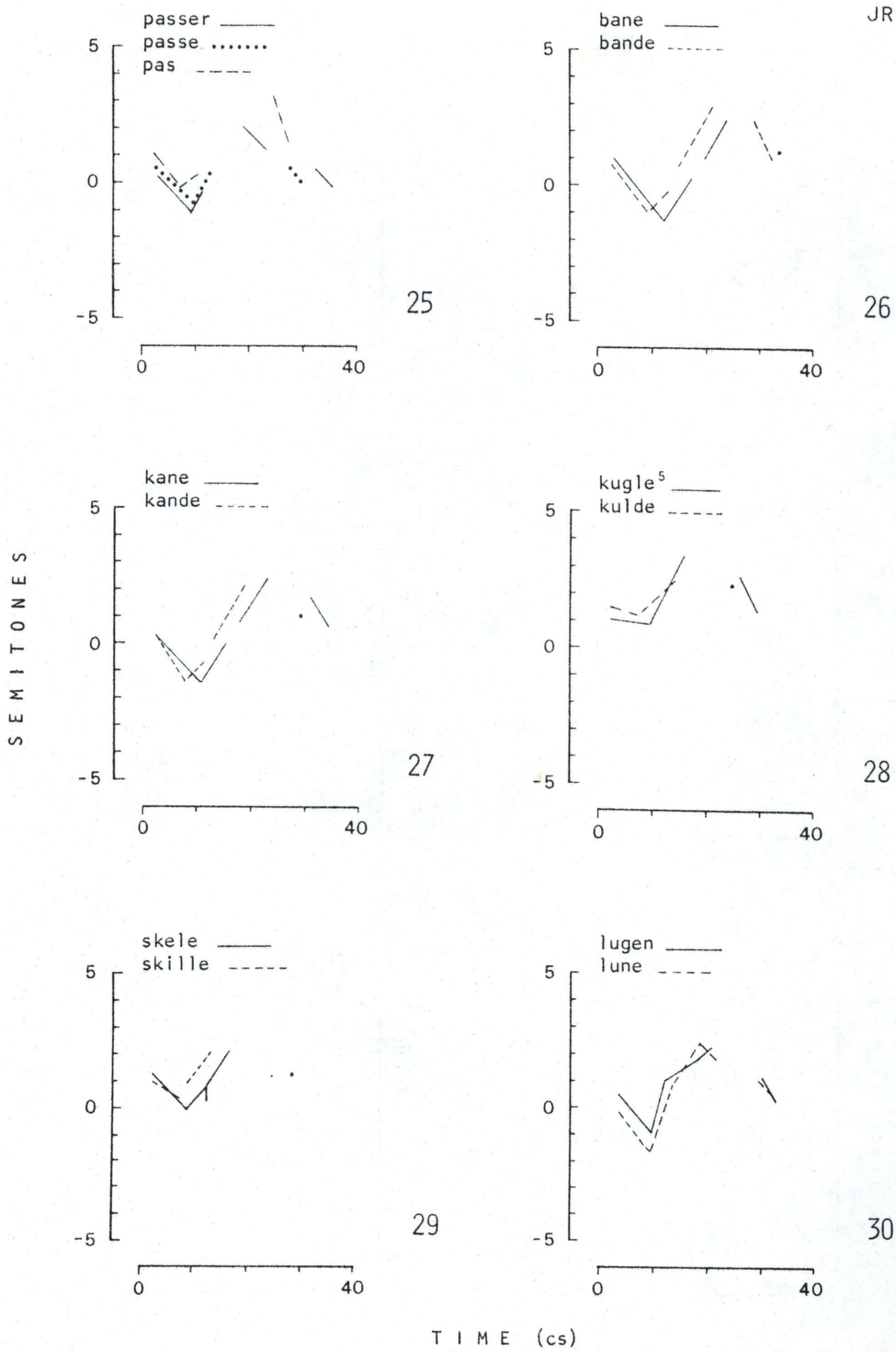

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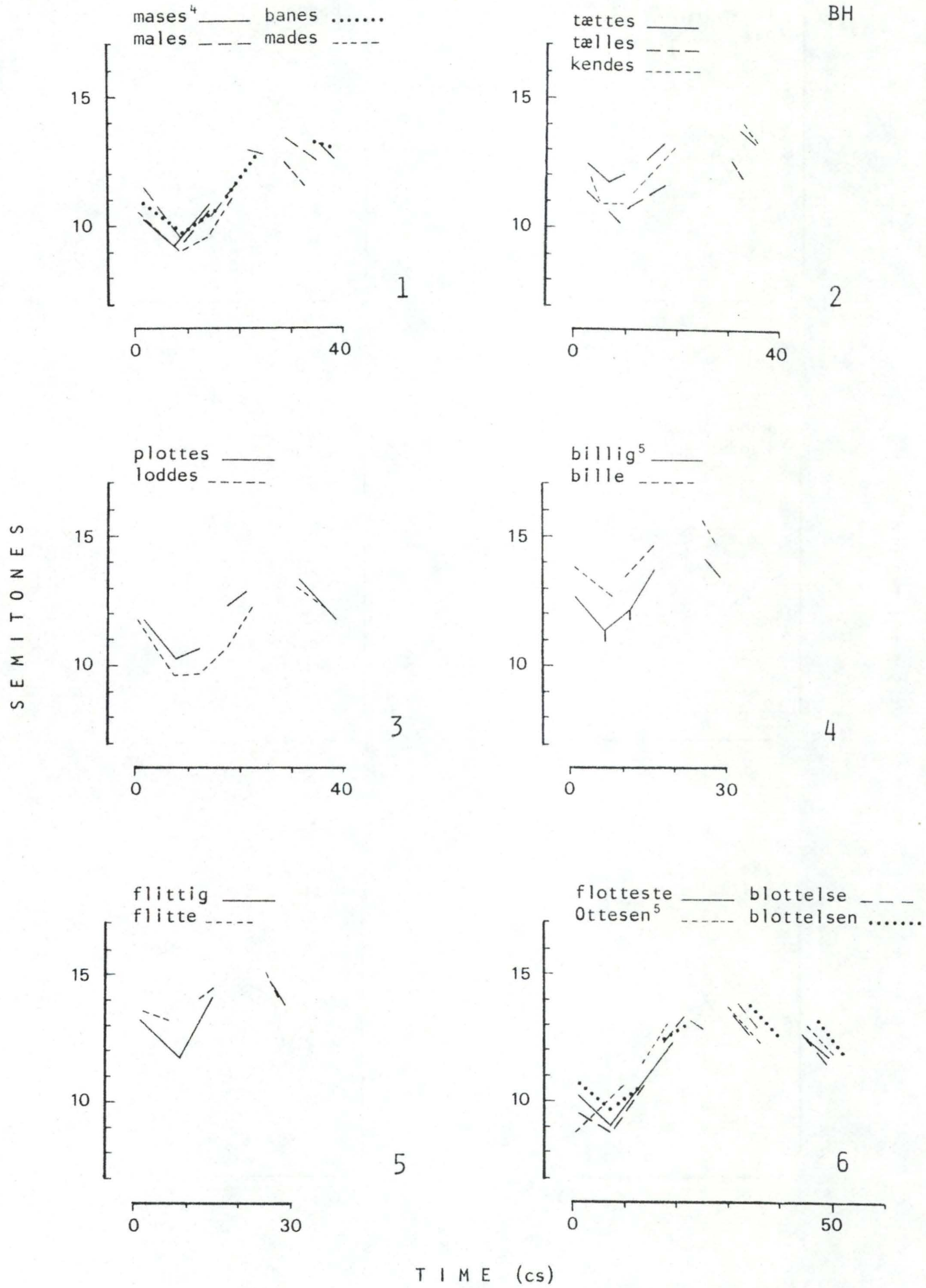
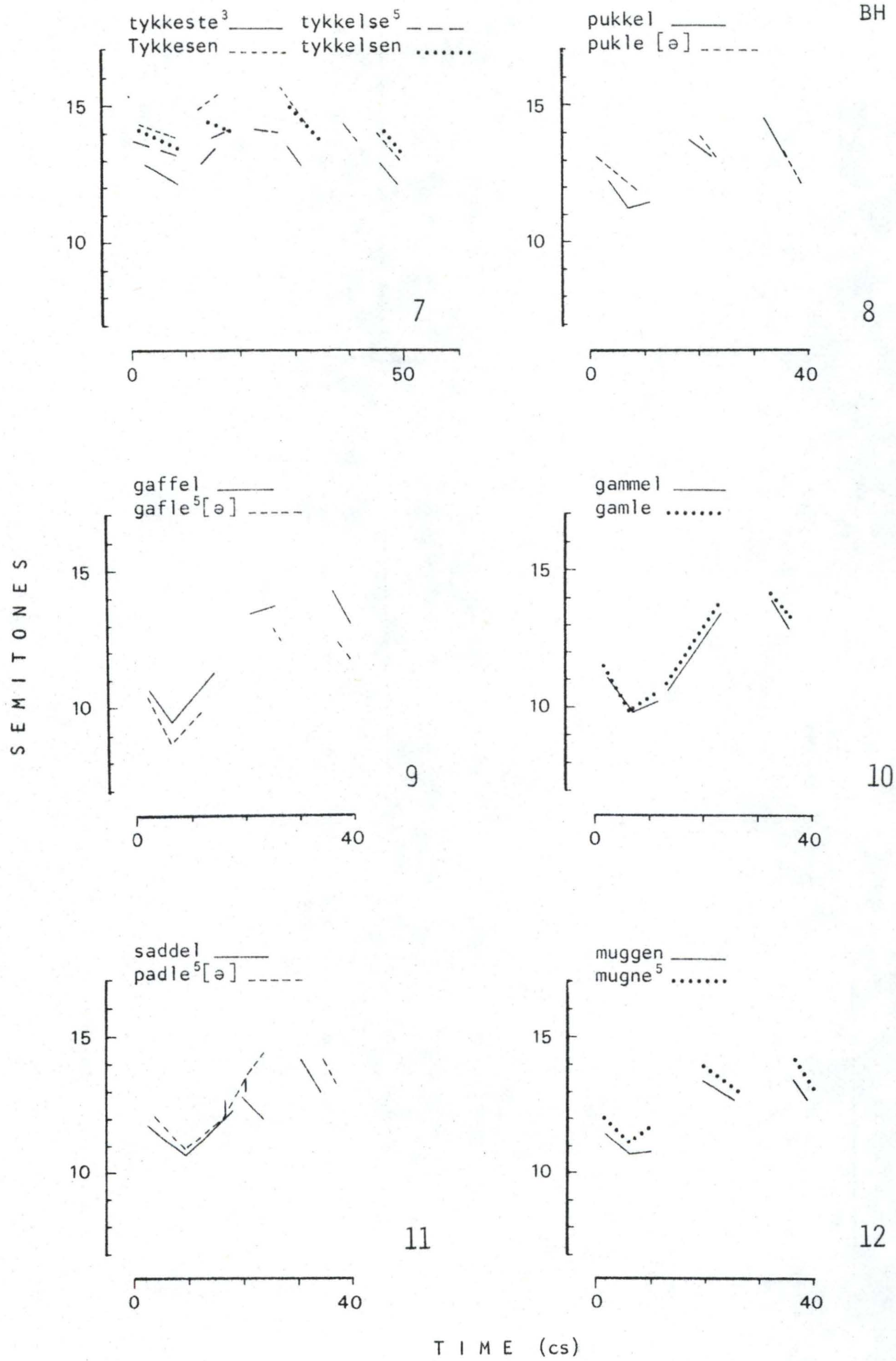


Figure 3

Subject BH. See further the legend to figure 1.



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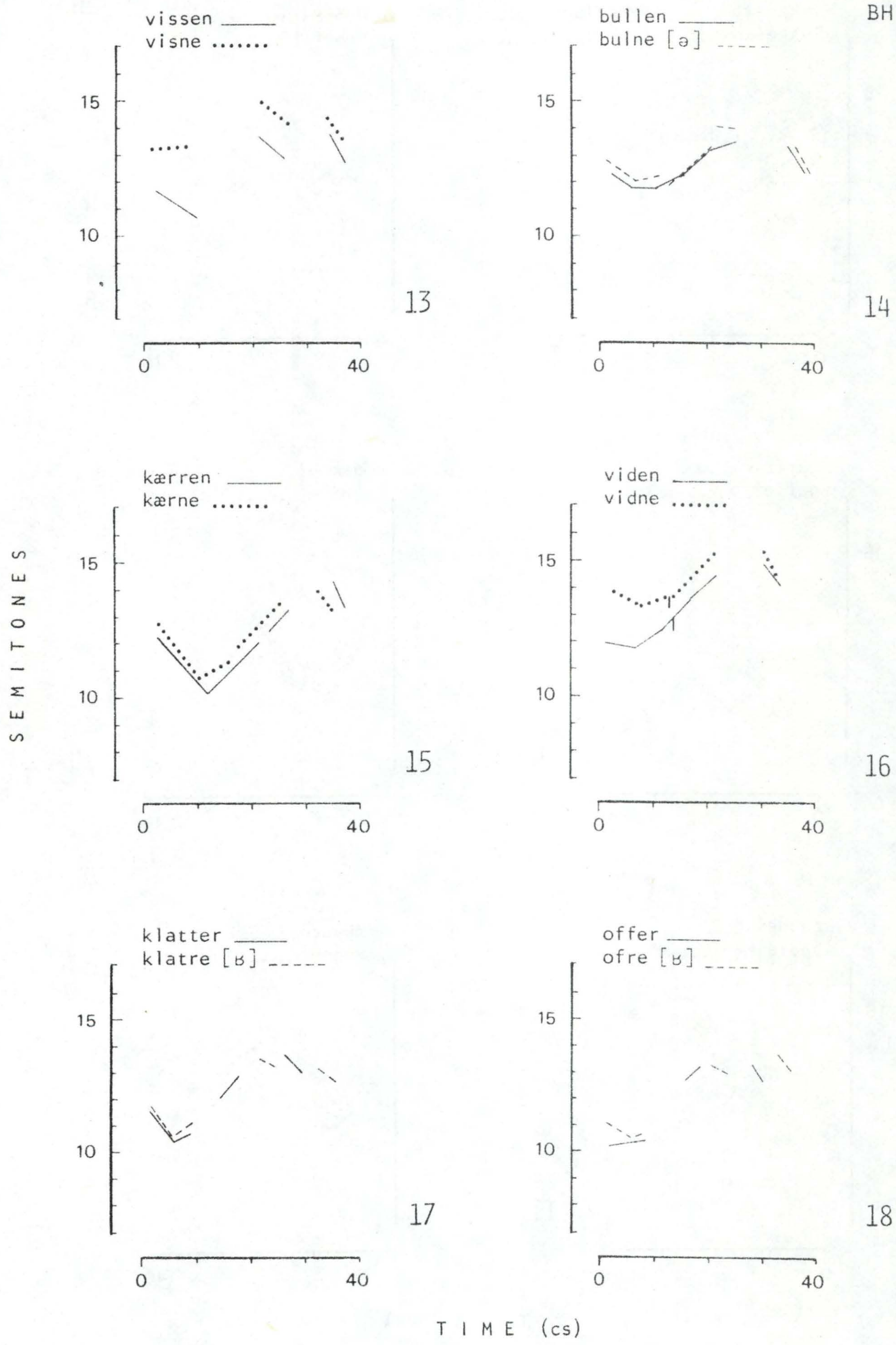

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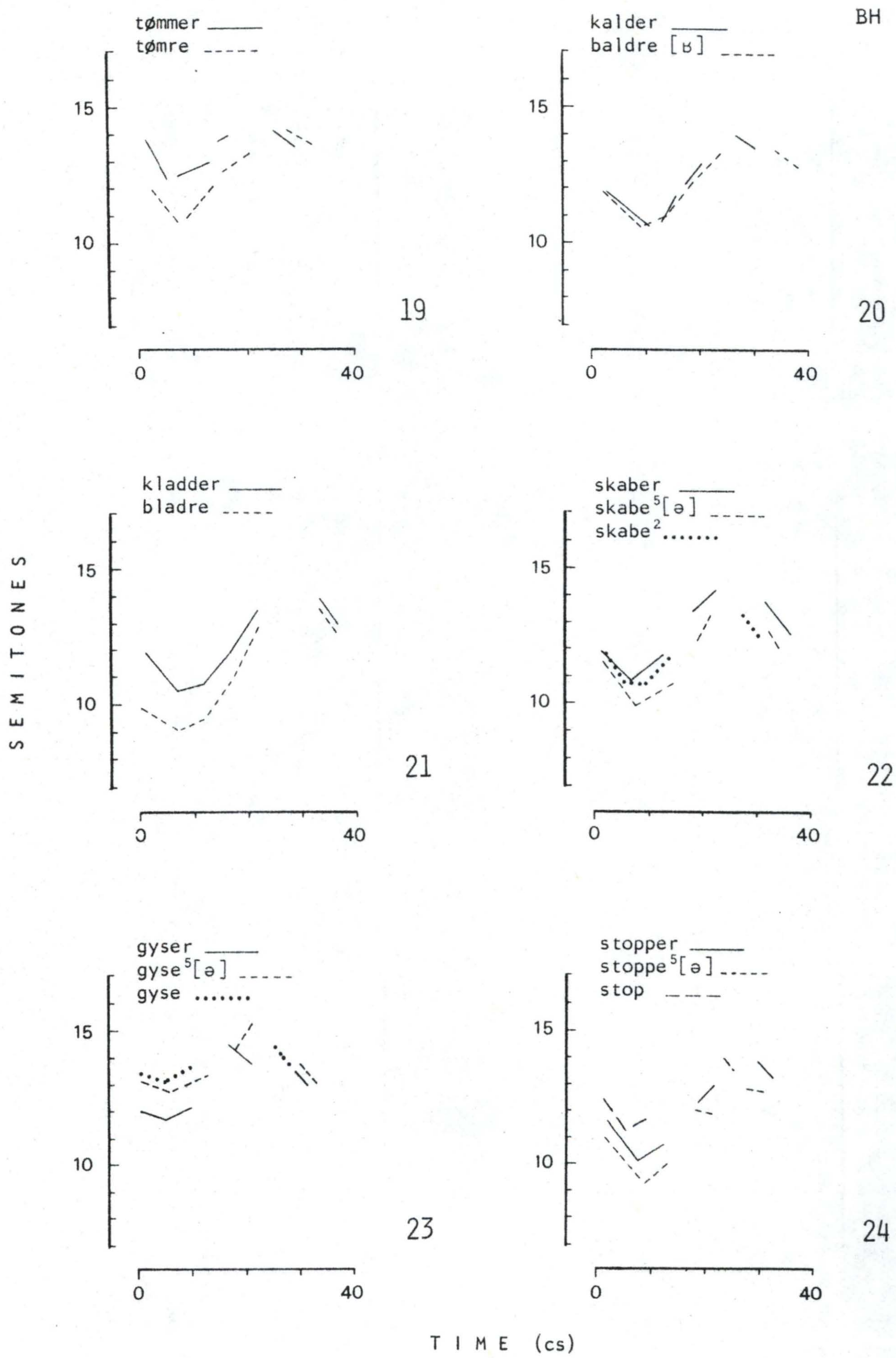

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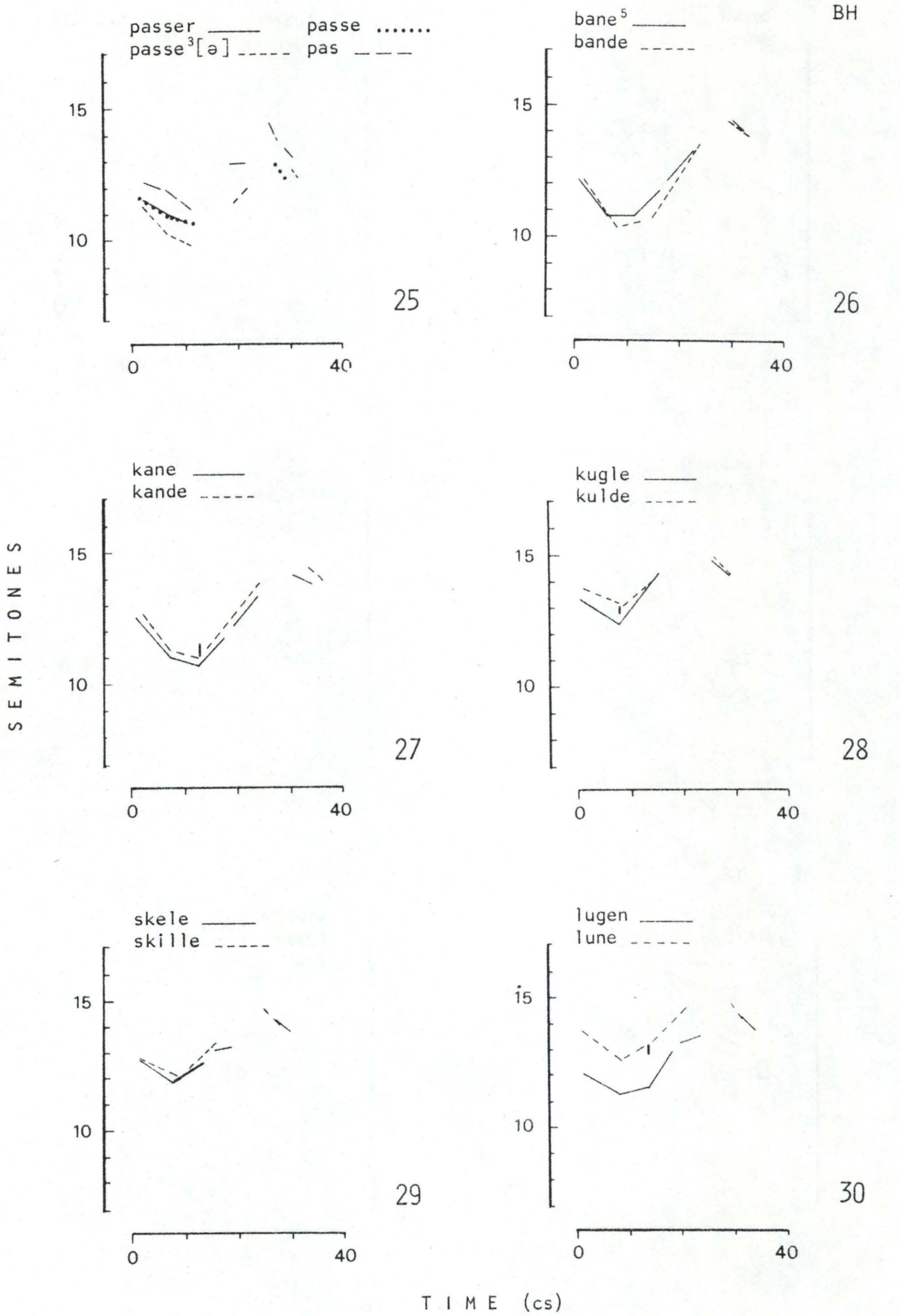

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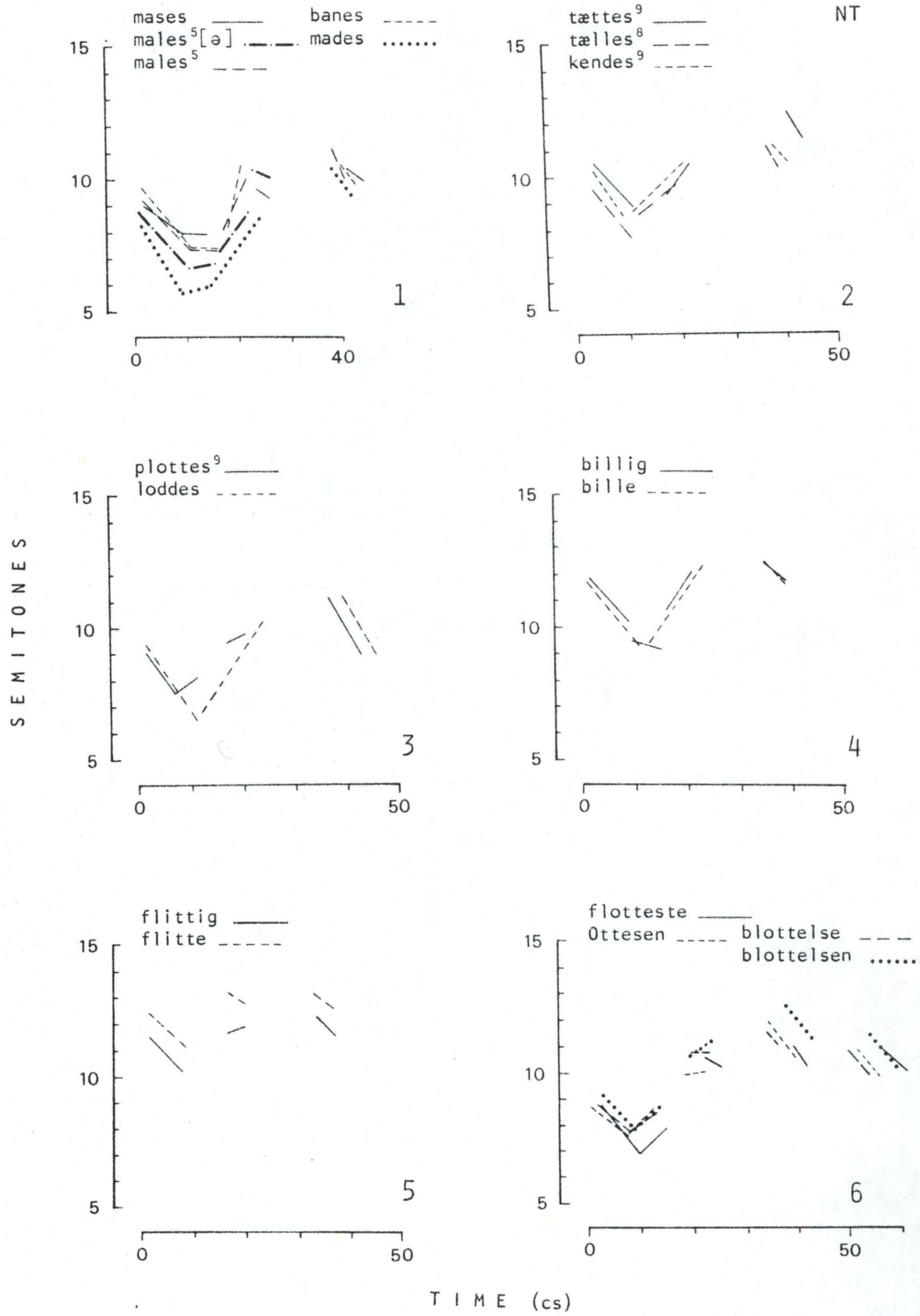
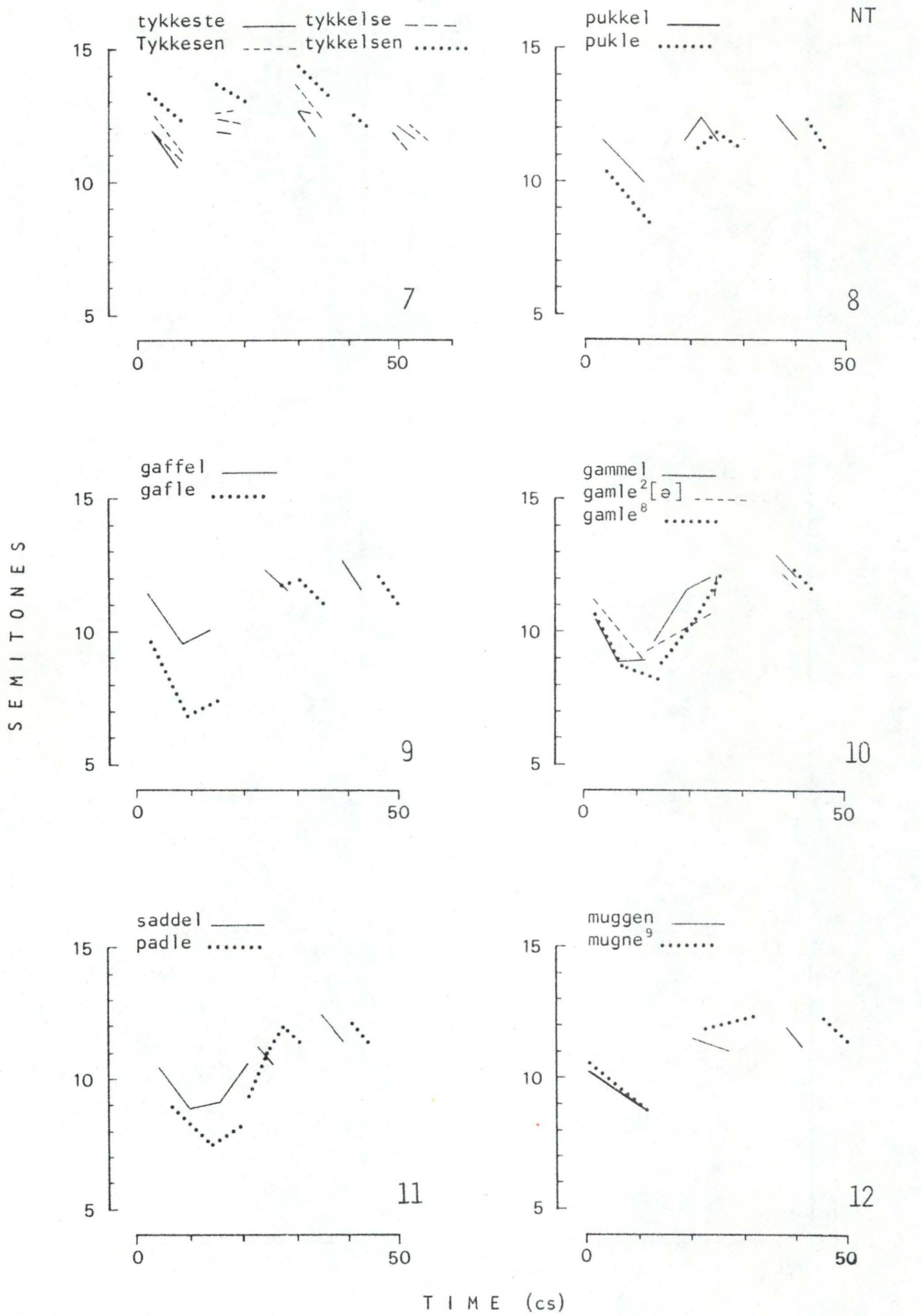


Figure 4

Subject NT. A raised numeral after the signatures in each frame indicates the number of items behind the average tracings, if it deviates from ten. See further the legend to figure 1.



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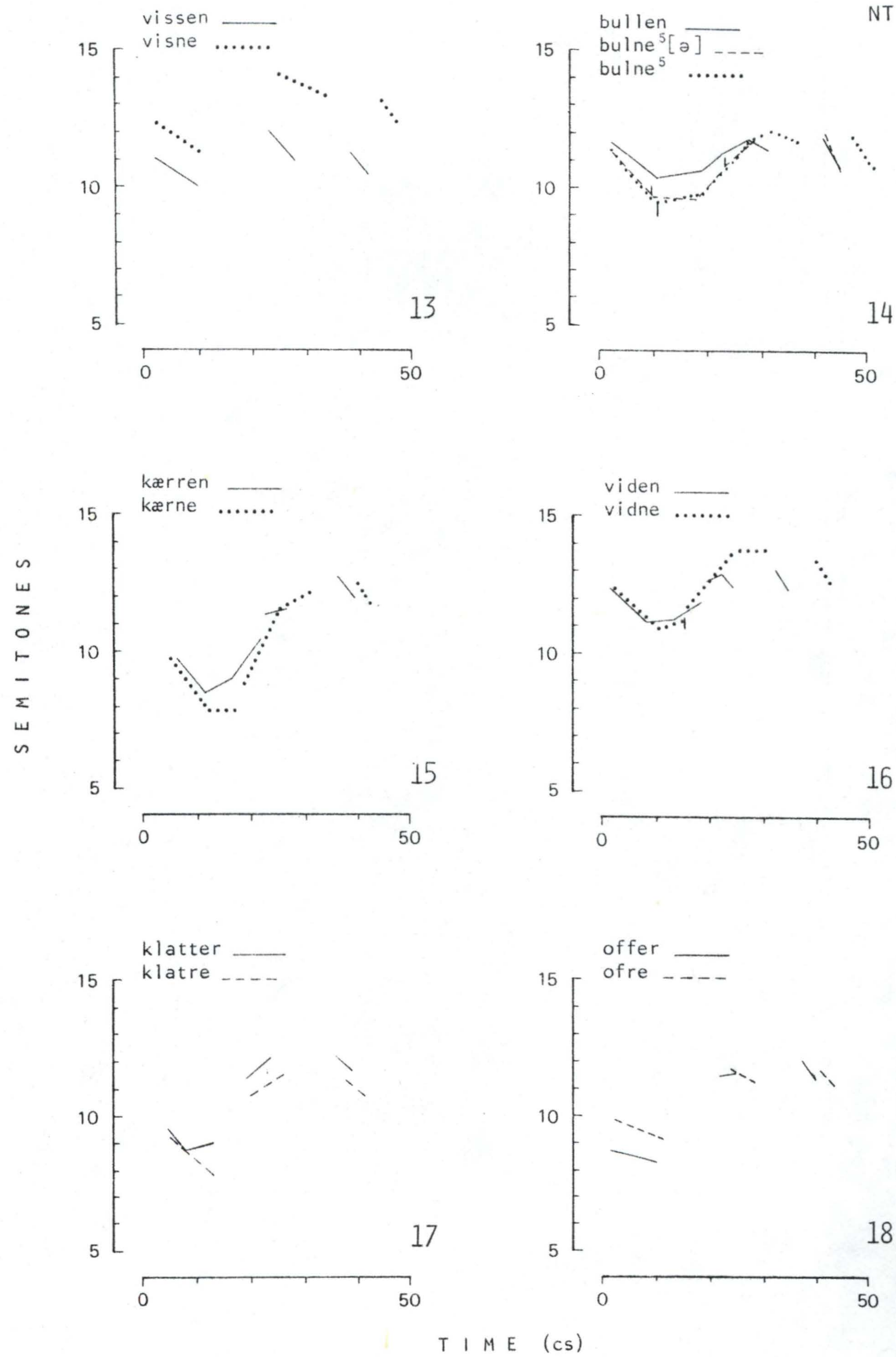

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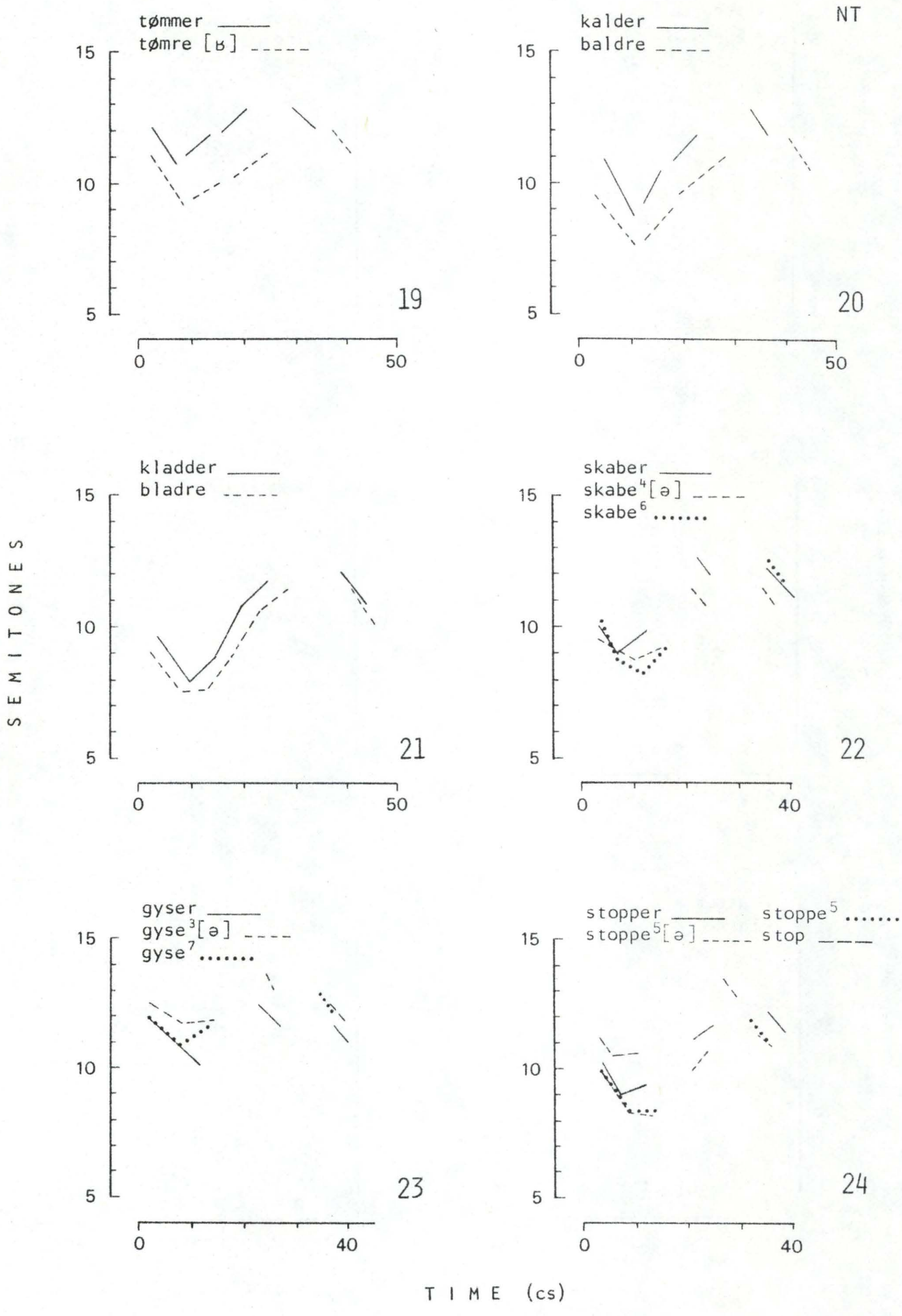

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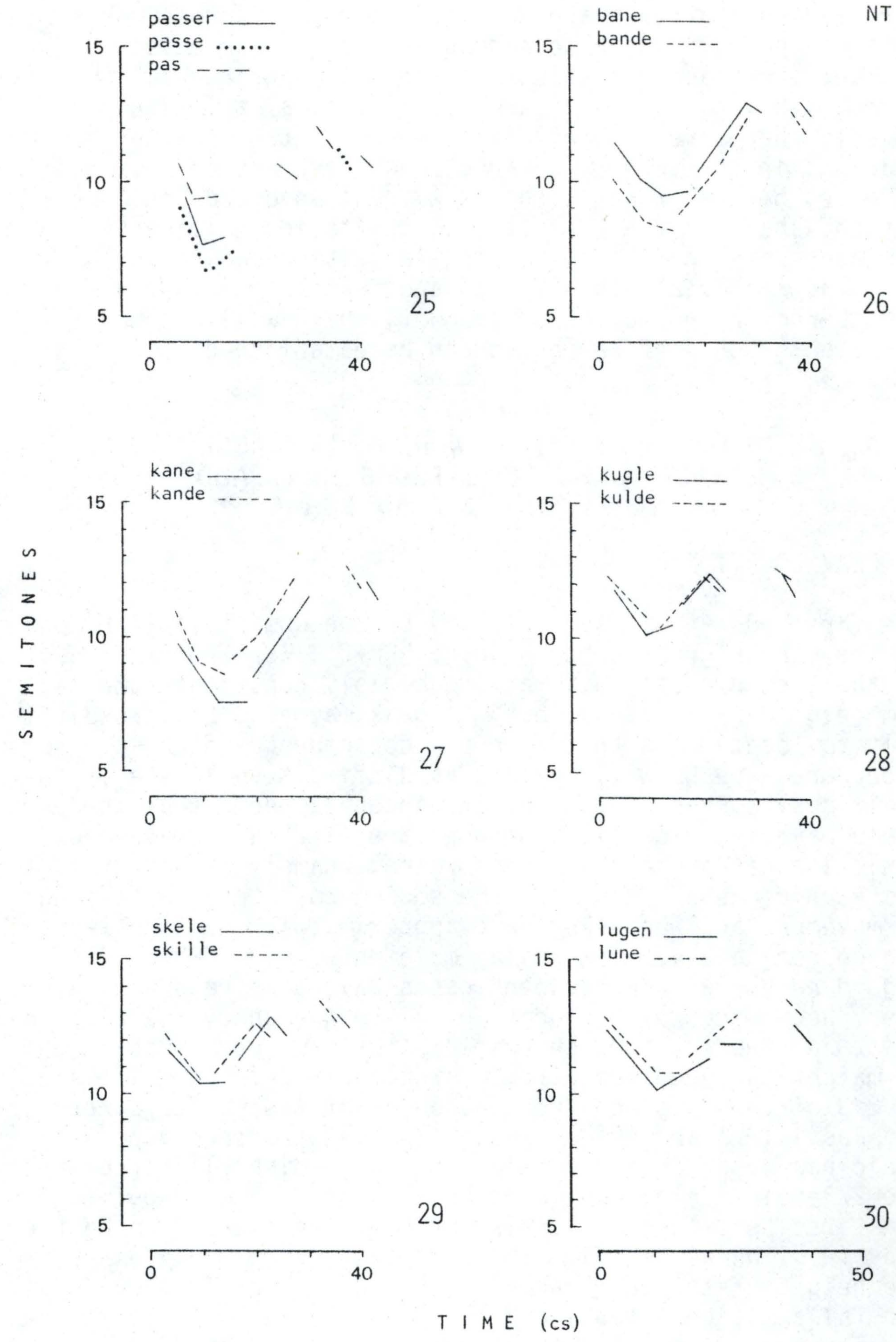

(figure 4 continued)

The most striking feature about figure 1-4 is how similar the stress group patterns appear to be, not just across words within a given frame but also across frames and subjects. Of course, there are variations in the low-high interval (correlated with variations in stressed vowel quality, higher or lower), there are (slight) differences in the location of the tracings in the frequency range, and there are obviously differences between words with and without unvoiced consonants. But the shape of the Fo pattern with its low falling start, the high rise and the succeeding fall is recognizable throughout practically all the figures and frames. This should be remembered in the following account, which will attempt to highlight such differences as can be established.

A. Fo PEAK LOCATION IN WORDS WITH ASSIMILATED SCHWA, UNASSIMILATED SCHWA, AND VOWEL OTHER THAN SCHWA

1. PEAK LOCATION PROCEDURE

The first post-tonic syllable may be the unmistakable Fo peak in the stress group pattern (e.g. NRP-5 *flitte* and *flittig*) or the second post-tonic may indubitably constitute the maximum (e.g. NRP-2 *tælles*), but the peak may also be more difficult to locate (and this is not a consequence of the averaging procedure - peaks will be just as difficult to locate in the individual curves). In many instances it seems that the peak would have occurred right between the first and second post-tonic if that passage had been voiced, namely when the first post-tonic has a rising and the second post-tonic a falling Fo movement and when they have approximately the same level and do not have very extensive movements (e.g. NRP-2 *tættes*). A good number of "in between" cases have been resolved, however, according to the location on the frequency scale of the point in time within each voiced stretch which may be taken to match its perceived pitch most closely (viz. the Fo value at 2/3 of the distance from the onset of the voiced stretch, cf. Rossi 1971 and 1978), typically when the second post-tonic has an extensive falling movement which clearly brings the 2/3-point below the level of the corresponding point in the first post-tonic which is therefore considered to be the peak (e.g. NRP-4 *bille*). This procedure completely disregards the height of the peak above the preceding Fo minimum; Fo rises and falls may be extensive or minimal: a peak is a peak, be it high or slight, with the quantification adopted here.

2. INDIVIDUAL DIFFERENCES

In table I-IX (Appendix III) the information on Fo peak location is given in the shape of a simple enumeration of the number of words in the tracings that have their peak in the first post-tonic syllable (A), between the first and second post-tonic (B), and in the second post-tonic syllable (C), as judged by the average tracings in the figures. The total number of words of a particular type does not always add up to the same figure with all four subjects: some would pronounce a given word with [ə], others would assimilate it, but a subject might also pronounce the same phonological word in two different ways, in which case each pronunciation counts as a word (see figure 1-4 and appendix I). This means that although there are 69 phonologically different words in the material, the actual number is 73 with NRP, 74 with JR, 71 with BH, and 73 with NT, since they pronounced 4, 5, 3, and 6 words, respectively, in two different ways, and then one of BH's words (*tykkelse*) and two of NT's (*flotteste, passer*) defied categorization.

In the vast majority of words JR has the Fo peak in the first post-tonic syllable and so does NRP in a fair majority. These two subjects would be in good agreement, then, with what is implicit in Rischel's (1970) findings. With BH and NT the variation is greater and a good many late Fo peaks occur, cf. Table I. One reason for the difference between, on the one side, JR and NRP and, on the other side, BH and NT, a difference which is statistically significant ($p < 0.0005$), is that with BH and NT the fall of Fo in the post-tonic syllables is rather slight, wherefore a peak is not always easily determined and - due to the procedure employed - tends to be located between the first and second post-tonic or later. I do not think that this difference is a systematic male/female difference, because a slight fall through the post-tonics was also characteristic of a male subject in a previous investigation (subject SH, Thorsen 1978). The difference between NRP and JR versus BH and NT should be kept in mind through the following paragraphs.

3. SYLLABIC CONSONANT VERSUS VOWEL

In the words of part (1) (frame 1-7, table II) the distribution of Fo peaks is not significantly different with any subject, nor with subjects' total, in words with pronounced [ə] versus words with assimilated schwa. Nor is there any significant difference between the words with schwa versus the words with [i] in the post-tonic. However, a tendency appears for more words to have a later Fo peak when the first post-tonic syllable is carried by a consonant. Of course, we are not limited to part (1) in a search for a dependency between Fo peak location and phonetic composition of the post-tonic syllable. In table III are included all words in the material, and the tendency just noted appears more clearly here, the difference being significant with BH and the total. Again, no significant difference appears between schwa and any other vowel, so we may consider schwa and other vowels in the first post-tonic together vis-a-vis a syllabic consonant (table IV).

Words with two successive schwa-syllables (frame 6-7) do not appear to differ significantly from the disyllables, i.e. there is no instance of a peak located in the third post-tonic syllable and - probably due to the very limited number of items -

there is no clear systematism in peak location and segmental structure in the first post-tonic either (table V).

Concludingly, and in answer to the first set of questions in section II, we may state that there is an overall tendency - but really not very strong - for a later Fo peak location (i. e. later than in the first post-tonic syllable) in words where the post-tonic syllable is carried by a syllabic consonant than in words with a vowel (irrespective of its quality) in the first post-tonic. Peak locations later than the second post-tonic syllable do not occur. Note, however, that there are considerable differences between the subjects as to the location of Fo peaks and one (JR) has hardly any "delayed" peaks at all.

4. FURTHER SEGMENTAL DIFFERENCES

Of course, the weak overall tendency to delayed Fo peak location in words with a syllabic consonant in the first post-tonic may conceal differences within this group of words. Table VI shows that there is no significant difference between peak locations in words with a syllabic consonant after a short and a long vowel, though NRP has a tendency to later peaks after short vowels. Table VII indicates a tendency (significant with BH and NT and subjects' total) to later Fo peaks when the syllabic consonant follows directly after the vowel than when a consonant intervenes. Table VIII shows that when a consonant intervenes between the stressed vowel and the syllabic consonant it is immaterial whether the syllabic consonant derives from /Cə/ or /əC/: the majority of these words have the peak located in the first post-tonic, like they do when [ə] is pronounced. Likewise, there is no apparent tonal difference between words of the /ˈ-VCər/ versus /ˈ-VCrə/-type, whether [ʁ] is pronounced or not, cf. table IX. All these facts are connected with durational relations, cf. section B.2 below.

The data in table VIII and IX thus offer an answer to the second set of problems in section II: instances where schwa assimilation or [ʁ]-vocalization may lead to lengthening of a preceding consonant (see section C. below) have no obvious tonal consequences neither in terms of differences in Fo peak location nor in terms of differences in Fo movements, cf. frame 8-21. With table VI and frame 26-29 (and particularly table XVIII, cf. section B.) the assertion is verified that syllabic consonants after short vowels are longer than after long vowels and it is also roughly true that the Fo peak is later relative to the start of the consonant after short vowels (cf. section II (3)). - It appears from frame 30 that the one word pair in the material with a clean "pure" versus non-"pure" assimilation (in BL's terminology, cf. section II) has the expected difference in consonant and vowel durations: the consonant is longer and the vowel sound shorter in *lune* [ˈluˑn̩] than in *lugen* [ˈluˑun], but their tonal course is identical.

Incidentally, there is no support for BL's statement (p. 197) that the second [u] in *lugen* should lose its syllable-constituting pitch (cf. section II): the post-tonic syllable in the word is rising with all subjects, and constitutes the Fo maximum in the stress group with NRP and JR. (BL's example is *luen* rather than *lugen*; this difference is of no consequence for the argument, since these two words are pronounced alike at the level of distinctness where schwa assimilation takes place.)

5. PEAK LOCATION AND WORD ACCENTS

Eva Gårding (personal communication) has suggested that different tonal behaviour in the words under investigation might reflect a difference related to the Accent I/Accent II distinction in Swedish (see Gårding 1977), and she kindly supplied me with accent indications of those 53 words that have direct counterparts in Swedish. 8 of these 53 words only are "Accent I" words, namely *pukkel, gaffel, saddel, offer, tømmer, skabe, stop, pas*. In table X the distribution of the 6 polysyllabic "Accent I" and 45 "Accent II" words according to the location of the Fo maximum is shown. Fo peaks are not significantly differently distributed in the two groups of words, nor is any tonal difference apparent from the figures and there are hardly any grounds to relate such differences as have been found in the material in Fo peak location to an "underlying" Accent I/Accent II distinction.

B. F_0 PEAK LOCATION AND DURATION

1. CONSTANT Fo PATTERNS

On previous occasions (most recently in Thorsen 1982) I have suggested a description of stress group patterns in terms of an essentially invariant fundamental frequency wave upon which the segments and syllables are superposed, in a manner that makes intrasyllabic Fo movements predictable from the shape of the wave where they hit it (falling, rising etc.), Fo movements which may be modified by microscopic (segmental) phenomena. The shape of the wave and the timing of stressed and unstressed syllables with respect to its trough and peak both vary across dialects. In Standard Danish the stressed vowel hits the wave in the trough before the fairly steep rise to the peak, which generally makes short stressed vowels falling, whereas long stressed vowels will be falling-rising (with a smaller rise than fall, see e.g. NRP-27-30, JR-27, 29, BH-27, 29, NT-27-30 where the boundary between the long vowel and succeeding sonorant consonant is clear). The height of the peak above the trough and the slope of the succeeding falling flank are subject to a certain amount of individual variation, as also witnessed by figure 1-4 here.

It seems from previous analyses that stress group patterns are simply truncated, cut short, when the stress group does not contain sufficient segmental material for a full low + high rise (+fall) to develop. Thus, e.g., a stress group consisting of one stressed syllable with a short vowel surrounded by unvoiced consonants will not turn up with a time compressed low + high rise Fo movement, but will be simply falling (see further Thorsen 1982).

With an account along these lines, the variation in Fo peak location with respect to the first post-tonic syllables observed in the present material should be correlated with differences in duration: if the stressed plus first post-tonic syllable together are too short to make it to the peak of the wave, the first post-tonic will be located on the rising flank, and the peak will then be "delayed" and lie in the second post-tonic syllable only. Note, though, that strictly speaking it is not the Fo peak which is delayed, but the first post-tonic which arrives too early.

2. PEAK LOCATION AS A FUNCTION OF DURATION

To establish the relation between Fo peak location and duration the duration from the onset of the stressed vowel to the offset of voicing in the post-tonic was measured, and the hypothesis is, then, that this entity ("S+P") will be shorter in words whose Fo peaks are mainly located later than the first post-tonic, and vice versa. In appendix IV are assembled tables that contain such durational data. In table XI all the words of the material are included and the average duration of S+P in words with the peak located in the first post-tonic (A), between the first and second post-tonic (B), and in the second post-tonic syllable (C) is given. Even though each group includes words of somewhat different segmental structure and duration, the hypothesis advanced above is borne out: S+P is longest in words with the Fo peak in the first post-tonic and shortest in words with the peak in the second post-tonic; the majority of these differences are statistically significant. However, subjects differ among themselves with respect to the absolute values. Thus e.g. with JR, an S+P of about 17 cs is sufficient for a full (fall-)rise to occur, a duration which is almost certain to truncate the rise with NRP, BH and NT and to shift the peak to the second post-tonic.

Table XII-XVI contain further documentation for a dependency of peak location on duration. In section A.4 above I noted that there are no significantly later peak locations in words with syllabic consonant after a short than after a long vowel, though such a tendency appears with NRP (table VI). In table XII the duration of S+P in the words behind table VI is given and it turns out that there is a significant difference between S+P in words with short and long vowel with NRP and JR, but not with BH and NT. When JR deviates from the others in having a durational difference but no difference in peak location it is of course due to the fact that the duration of S+P in words with both long and short vowel is long enough to contain a full rise.

There was a tendency for later Fo peaks in words where the syllabic consonant directly succeeds the stressed vowel than where a consonant intervenes (table VII), significant with two subjects (BH and NT). From table XIII it appears that this difference corresponds to a durational one: S+P is longer with BH (significantly so) and NT in words where a consonant intervenes between stressed vowel and syllabic consonant. The difference is very slight with NRP and JR.

Table VIII and IX showed no differences in peak locations in words of the /ˈ-VCCə/ versus /ˈ-VCəC/ structure, which all had a majority of early peaks, and from table XIV and XV it is reasonable to conclude that this is due to the fact that S+P in all these words is long enough to contain the full Fo rise from the trough to the peak of the wave.

Table XVI carries the search for a dependency of peak location on duration into greater detail. The duration of S+P(s) in pairs of words which are minimally different segmentally but which do have a difference in peak location is listed. Out of a total of 15 word pairs with different peak locations, only three do <u>not</u> have statistically significant differences in the S+P <u>duration</u>.

3. CORRELATING THE HEIGHT AND DURATION OF Fo RISES

Due to the structure of the word material there are few instances where Fo is continuously rising-falling and where the location of a physically manifest Fo turning-point (maximum) can be accurately and unmistakably located in time and frequency. It is therefore not possible to see how constant are the time and frequency coefficients of Fo peaks relative to the preceding minimum in the stressed vowel. (According to the description of stress group patterns as more or less invariable Fo waves <u>and</u> to the results reported above one would expect the peak <u>of</u> the pattern to be fairly constant in both dimensions relative to the preceding trough, everything else being equal, i.e. for a given vowel height and for a given position of the stress group on the intonation contour: early or late, high or low, cf. Thorsen 1980.) - Another aspect of the 'constant wave' description <u>can</u> be tested, however: the magnitude of the rise from the <u>minimum</u> in the stressed vowel should be positively correlated with its duration (because the pattern is truncated by unvoiced consonants rather than time compressed. In other words: the sooner a rise is cut off the smaller it will be). Such a positive correlation does indeed exist, cf. table XVII. Considering that a straight line is probably not the best representation of these data points (since the rising movements are generally parabolic rather than rectilinear) and considering also the varying segmental make-up of the words (higher/lower stressed vowel, different succeeding consonants), these correlation coefficients (between 0.78 and 0.94) are comfortably high and highly significant ($p < 0.0005$).

C. SCHWA ASSIMILATION AND DURATION

1. SYLLABIC CONSONANTS AFTER LONG AND SHORT VOWELS

Syllabic consonants after short vowels (which exhibit "pure" assimilation in BL's terminology) should be longer than after long vowels, cf. section II (3) and IV.A.4. In table XVIII the duration of the vowel, syllabic consonant and their sum in four word pairs which have a clean vowel length difference is given. The syllabic consonant after a short vowel is about 3-4 cs longer than after a long vowel with three subjects, but with JR the difference is considerably smaller (between 0.6 and 2.2 cs). The difference in vowel duration is always larger than the difference in the consonants and the duration of vowel plus consonant is significantly longer in the long vowel words than in the short vowel words with three subjects.

According to BL's description (p. 197) that the first part of the extra long syllabic consonant after a short vowel has been articulated before the second pitch is initiated and according to my own account above of Fo patterns, the four word pairs should have identical Fo courses but the long vowel/consonant boundary should be shifted upwards on the rising Fo flank relative to the short vowel/consonant boundary. This description covers subject BH perfectly well, cf. frame 26-29, but with NRP, JR and NT the words with low vowels (*bane-bande, kane-kande*, frame 26-27) deviate: it seems that the Fo fall is extended (JR) or levelled out (NRP and NT) in the long vowel to the effect that the Fo rise as a whole is shifted to the right. With JR a rise in the final part of the long vowel is retained but this cannot be said of NRP and NT. The same tendency appears in *skele-skille* (frame 29), though less pronounced, but it is lacking in *kugle-kulde* (frame 28). I cannot at present explain this phenomenon: If the difference in Fo pattern were simply one of short vowel versus long vowel it should at least generalize to all vowel qualities (if not necessarily to all speakers). The effect could be due to the long vowels being extra long through compensatory lengthening (which can neither be proved or disproved the way the material is structured), and one could well imagine such a process to hold up or discontinue the normal course of Fo patterns, but then again it should at least generalize to all vowels (if not all subjects), and furthermore such a compensatory lengthening should take place also when the long vowel is succeeded by an obstruent and schwa is elided (as in *skabe, gyse*), which is not the case, cf. section 3 below.

These "held-up" or delayed Fo rises are worthy of a closer inspection because whatever the cause, they are an indication that Fo patterns <u>may</u> under some conditions be more actively controlled than I have assumed. For instance, a variety of Copenhagen Danish (Low Copenhagen in BL's terminology, p. 605-608) has a lengthening of short vowels in stød-less syllables. Will such syllables have delayed Fo rises, and will this be one of the means by which short and long vowels are distinguished acoustically and perceptually (in pairs like e.g. *kulde-kugle*)?

2. LENGTHENING OF THE PRECEDING CONSONANT

According to BL (p. 198ff), the post-vocalic consonant preceding the syllabic one in the /ˈ-VCCə/ type is lengthened when the syllabic consonant is the more sonorous of the two. Thus the post-vocalic consonant in *pukle, gafle, gamle, mugne, visne* should be longer than in *pukkel, gaffel, gammel, muggen, vissen*. Also, the syllabic consonant should be longer when it derives from /Cə/ than from /əC/. No lengthening should occur in the post-vocalic consonant of *padle, bulne, vidne* relative to *saddel, bullen, viden*. On the contrary, the post-vocalic consonant in the latter three words is the syllabic one (due to its greater sonority) and therefore it should be lengthened.

First of all, there are frequent and significant differences in the duration of the stressed vowel in the word pairs, but the differences are generally small (1-2 cs), and there is no consistent trend in their direction, cf. table XIX (a) and (b). Therefore, I shall assume that when there is a substantial difference in the duration of an unseparable vowel plus consonant(s), the stressed vowel has no part in it.

When the post-vocalic consonant is an obstruent there is a clear tendency towards the obstruent being longer in the /CCə/ type but the difference is fairly small (1-3 cs) and the rule is not without (random) exceptions. Moreover, these lengthenings are not confined to instances where schwa is assimilated, they occur also when schwa is pronounced.

Due to three subjects pronouncing [ə] and also due to segmentation difficulties *bulne-bullen* is not revealing, but from *padle-saddel* and *vidne-viden* it seems fair to conclude that the post-vocalic consonant is not lengthened, since [að] and [ið] as expected are shorter - if anything, in *padle* and *vidne*.

It is hard to say where *gamle-gammel* fits in. The pair should belong to the group of words with a post-vocalic obstruent, since [m] is less sonorous than [l] and thus both should be lengthened in *gamle*. This is hardly the case: the whole [ɑml̩] sequence is significantly longer in *gamle* with NRP and NT, but to judge from NT's data, this is mainly due to a longer syllabic consonant. With BH [ml̩] is significantly shorter in *gamle*, and with JR there is no significant difference anywhere. It is tempting to speculate that *gamle-gammel* team up with *padle-saddel* etc. in which case the criterion for lengthening of a preceding post-vocalic consonant is not the narrower one of their mutual sonority relation but a question of the post-vocalic consonant being, phonetically, an obstruent - which is lengthened - or a sonorant - which is not, and the lengthening takes place whether schwa is actually dropped or not.

The syllabic consonant shows a clear tendency to be longer (2-4 cs) when it derives from /Cə/ than when it derives from /əC/, irrespective of the nature of the preceding consonant, but there are also (random) exceptions to this rule.

Lengthening due to [ʁ]-vocalization (table XIX (c)) is fairly straightforward: when [ʁ] is vocalized the preceding consonant is longer in the /-Crə/ than in the /-Cər/ type. The considerable differences in *klatre-klatter* are partly due to the intervocalic flap-like stop in *klatter* being particularly short. BL may be correct in stating that lengthening is obligatory when [ʁ] is vocalized but only optional when [ʁ] is pronounced, since the only instances of non-significant differences in the duration of the post-vocalic consonant occur when [ʁ] is in fact pronounced.

3. SCHWA ELISION AND DURATION

From table XX it seems that when schwa is dropped word finally after an unvoiced consonant (*skabø, gysø, stoppø, passø*) it really leaves no trace in the durational pattern. There are hardly any significant differences in the duration of the post-vocalic consonants and only one word (NT-*passø*) has a longer consonant word finally after schwa-elision. Nor are there consistent and significant differences in the duration of the stressed vowel in words with elided schwa versus disyllabic words with pronounced [ə] or [ʌ] (*skabø* and *passø* with NT have a longer vowel than *skabe, skaber* and *passer*, but *gysø* with BH and *passø* with NRP have shorter stressed vowels than *gyser* and *passer*, respectively).

Incidentally, Fischer-Jørgensen (1964 and forthcoming) found a consistent trend towards longer stressed vowels in disyllables than monosyllables, ceteris paribus. In utterance medial position the difference averaged 2.5 cs. In the present (limited) material this rule is not without exceptions: three monosyllables (of a total of eight) do not have significantly shorter vowels than their disyllabic partners (JR's *stop*, BH's and NT's *pas*).

The slope of the Fo rise from the minimum in the stressed vowels (in semitones per second) is indicated to the right in table XX. If a (partial) compression of the Fo pattern into the stressed vowel takes place when schwa is elided, then these slopes should be steeper than when schwa (or any other vowel) is pronounced. Such steeper rises are indeed found in some words with some subjects (NRP *skabø, gysø, stoppø;* JR *gysø, stoppø;* NT *skabø, gysø, passø*). However, it is not a general pattern. Secondly, there are also considerable (but random) differences in the slope of the Fo rise within the stressed vowel in otherwise comparable disyllabic words (NRP, JR and NT *skabe-skaber*). Thirdly, some words with schwa elision have no rise at all (BH *passø;* NT *stoppø*). This variation in the movement of the stressed vowels should be ascribed to a variation of the exact timing of the vowel with respect to the trough of the Fo wave, cf. section B.1.

Apparently, there are really no grounds for positing a general compensation of any sort (durational or tonal) when word-final schwa is elided after unvoiced consonants, as also foreseen by

Brink and Lund. The implication of that is that there is probably no context at all for compressed Fo patterns.

V. CONCLUSION

From the present investigation it would seem that if and when words with a syllabic consonant in the first post-tonic syllable turn up with an incomplete Fo pattern in the sense that the Fo peak is not coincident with the first post-tonic but is shifted (relatively) in time towards the second post-tonic, this is not a particular characteristic of syllables with assimilated schwa as such, but it is a consequence of the durational reduction involved in most instances of schwa assimilation. Furthermore, the height of the rise of Fo from the minimum in the stressed vowel and the duration of the rise are fairly highly correlated. These findings support a view of the stress group pattern as a more or less time and frequency invariant entity upon which syllables are superposed in accordance with their time structure. There are indications that under certain (probably rather narrowly defined) circumstances an Fo pattern may be held up in its course but the reverse phenomenon - time compressed patterns - does not seem to occur at all.

The durational structure of words with schwa assimilation conforms to Brink and Lund's (1975) predictions (except that none of the "rules" are without randomly occurring exceptions): Syllabic consonants after short vowels are longer than after long vowels; syllabic consonants deriving from /Cə/ are longer than those deriving from /əC/; in a group of two consonants between a stressed vowel and schwa (/ˈ-VC_1C_2ə/) C_1 is lenghtened if it has less sonority than C_2 (alternatively: "if it is an obstruent") - likewise, C_1 is lengthened if C_2 is /r/, whether [ʁ] is vocalized or not.

NOTES

1) I have translated Brink and Lund's Dania transcriptions into IPA and also occasionally supplied a phonemic transcription. - Syllabicity is indicated here with a dot under the consonant, long vowels with one dot after the symbol.

2) According to Brink and Lund (p. 193), sonority decreases through the consonants as follows: [ʏ w ð]; [ɣ l ʁ]; [m n ŋ]; [v]; unvoiced consonants.

3) Monosyllables with long vowel invariably take stød and since the stød may have tonal side-effects, monosyllables were excluded.

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REFERENCES

Brink, L. and Lund, J. 1975: *Dansk Rigsmål 1-2* (Gyldendal, København

Fischer-Jørgensen, E. 1964: "Sound duration and place of articulation" *Zeitschrift für Phonetik, Sprachwissenschaft und Kommunikation 17,* p. 175-207

Fischer-Jørgensen, E. forthcoming: "Segment duration in Danish words in dependency on higher level phonological units", (also in this volume)

Gårding, E. 1977: *The Scandinavian Word Accents,* Travaux de l'Institut de Linguistique de Lund 11 (Gleerup, Lund)

Rischel, J. 1970: "Acoustic features of syllabicity in Danish", *Proc. 6th Int. Congr. Phon. Sc.,* p. 767-770 (Academia, Publishing House of the Czechoslovak Academy of Sciences)

Siegel, S. 1956: *Non-parametric Statistics* (McGraw-Hill, Tokyo)

Thorsen, N. 1978: "An acoustical analysis of Danish intonation" *J. Phonetics 6,* p. 151-175

Thorsen, N. 1979: "Interpreting raw fundamental frequency tracings in Danish", *Phonetica 36,* p. 57-78

Thorsen, N. 1980: "Neutral stress, emphatic stress, and sentence intonation in Advanced Standard Copenhagen Danish", *Ann. Rep. Inst. Phon. Univ. Copenhagen 14,* p. 121-205

Thorsen, N. 1982: "On the variability in Fo patterning and the function of Fo timing in languages where pitch cues stress", *Phonetica 39* (also this volume).

APPENDIX I

Transcription and translation of the 69 words in the material - syllabicity is indicated with a dot under the symbol, duration with one dot after the symbol. The transcriptions are idealized from the point of view of the investigation, i.e. subjects may well deviate and pronounce a schwa where a syllabic consonant was "intended", or pronounce [ʁ] rather than vocalize it, or he/she may produce the same word in two editions - as indicated on the right hand side.

(1)

			NRP	JR	BH	NT
males	[ˈmæ·ḷs]	to be painted				∅/ə
banes	[ˈb̥æ·ṇs]	to be cleared		∅/ə		
mades	[ˈmæ·ð̣s]	to be fed				
mases	[ˈmæ·səs]	to be mashed				
tælles	[ˈd̥ˢɛlḷs]	to be counted				
kendes	[ˈg̊ʰɛnṇs]	to be recognized				
loddes	[ˈlʌðð̣s]	to be soldered				
tættes	[ˈd̥ˢɛd̥əs]	to be sealed				
plottes	[ˈb̥ʰlʌd̥əs]	to be plotted				
bille	[ˈb̥ilḷ]	beetle				
billig	[ˈb̥ili]	cheap				
flitte	[ˈflid̥ə]	fleam				
flittig	[ˈflid̥i]	diligent				
tykkelse	[ˈd̥ˢyg̊ḷsə]	thickness				
tykkelsen	[ˈd̥ˢyg̊ḷsṇ]	the thickness				
Tykkesen	[ˈd̥ˢyg̊əsṇ]	invented proper name				
tykkeste	[ˈd̥ˢyg̊əsd̥ə]	thickest				
blottelse	[ˈb̥lʌd̥ḷsə]	exposure				
blottelsen	[ˈb̥lʌd̥ḷsṇ]	the exposure				
Ottesen	[ˈʌd̥əsṇ]	proper name				
flotteste	[ˈflʌd̥əsd̥ə]	finest NRP: ˈflʌd̥əsd̥∅				

(2)

			NRP	JR	BH	NT
pukle	[ˈb̥ʰɔg̊·l̩]	to slog away	ə	ə	ə	
pukkel	[ˈb̥ʰɔg̊l̩]	hump				
gafle	[ˈg̊ɑf·l̩]	to pinch	ə	ə	ə	
gaffel	[ˈg̊ɑfl̩]	fork				
gamle	[ˈg̊ɑm·l̩]	old, pl.				ə̸/ə
gammel	[ˈg̊ɑml̩]	old, sg.				
padle	[ˈb̥ʰaðl̩]	to paddle			ə	
saddel	[ˈsaðð̥l]	saddle				
mugne	[ˈmɔg̊·n̩]	to go mouldy	ə	ə		
muggen	[ˈmɔg̊n̩]	mouldy				
visne	[ˈves·n̩]	to wither	n̩/ə	ə		
vissen	[ˈvesn̩]	withered				
bulne	[ˈb̥ul·n̩]	to swell	ə	ə	ə	ə̸/ə
bullen	[ˈb̥ull̩n]	swollen				
kærne	[ˈg̊ʰæʌ̆n̩]	to churn				
kærren	[ˈgæʌ̆ʌn]	the cart				
vidne	[ˈvið·n̩]	to testify	ə	ə̸/ə		
viden	[ˈviðð̥n]	knowledge				
klatre	[ˈg̊ʰlad̥·ʌ]	to climb	ʁ		ʁ	
klatter	[ˈg̊ʰlad̥ʌ]	(he) blots				
ofre	[ˈʌf·ʌ]	to sacrifice	ʁ	ʁ	ʁ	
offer	[ˈʌfʌ]	sacrifice				
tømre	[ˈd̥ˢœm·ʌ]	to do carpentry				ʁ
tømmer	[ˈd̥ˢœmʌ]	(he) empties				
baldre	[ˈb̥al·ʌ]	to smash	ʁ		ʁ	
kalder	[ˈg̊ʰalʌ]	(he) calls				
bladre	[ˈb̥lað·ʌ]	to turn over the leaves				
kladder	[ˈg̊ʰlaðʌ]	drafts				

(3)

			NRP	JR	BH	NT
bane	[ˈb̥æ·n̩]	track				
bande	[ˈb̥ann̩]	to swear				
kane	[ˈg̊ʰæ·n̩]	sleigh				
kande	[ˈg̊ʰann̩]	jug				
kugle	[ˈg̊ʰu·l̩]	ball				
kulde	[ˈg̊ʰull̩]	coldness				
skele	[ˈsg̊e·l̩]	to squint				
skille	[ˈsg̊ell̩]	to divide				
lune	[ˈlu·n̩]	warm				
lugen	[ˈlu·un]	the hatch				

(4)

			NRP	JR	BH	NT
skabe	[ˈsg̊æ·b̥]	closets	ə̸/ə	ə̸/ə	ə̸/ə	ə̸/ə
skaber	[ˈsg̊æ·b̥ʌ]	(he is) putting on an act				
gyse	[ˈg̊y·s]	to shudder	ə̸/ə	ə̸/ə	ə̸/ə	ə̸/ə
gyser	[ˈg̊y·sʌ]	thriller				
stoppe	[ˈsd̥ʌb̥]	to stop	ə̸/ə	ə̸/ə	ə	ə̸/ə
stopper	[ˈsd̥ʌb̥ʌ]	(he) stops				
stop	[ˈsd̥ʌb̥]	fill				
passe	[ˈb̥ʰas]	to fit			ə̸/ə	
passer	[ˈb̥ʰasʌ]	calipers				
pas	[ˈb̥ʰas]	passport				

APPENDIX II

The 69 test words of the material in their carrier sentences and their translations.

(1)

Huset skal males med penslen.
The house should be painted with the brush.

Kartoflen skal mases med gaflen.
The potato should be mashed with the fork.

Barnet skal mades med skeen.
The child should be fed with the spoon.

Vejen skal banes med traktor.
The road should be cleared with a tractor.

Klassen skal tælles til frokost.
The class will be counted at lunch.

Cyklen kan kendes på farven.
The bike is recognized by its colour.

Taget skal tættes til vinter.
The roof must be sealed before the winter.

Tinnet skal loddes med omhu.
The pewter must be soldered with care.

Kurven skal plottes med omhu.
The curve must be plotted with care.

Bredde og tykkelse skal passe til hinanden.
Width and thickness must match each other.

Bredden og tykkelsen skal passe til hinanden.
The width and the thickness must match each other.

Tyndesen og Tykkesen skal hjælpe hinanden.
Mr. Skinny and Mr. Stout should help each other.

Den største og tykkeste skal hjælpe de mindste.
The biggest and stoutest one should help the smaller ones.

Det værste var en blottelse til højre for midten.
The worst was an exposure to the right of the middle.

Det værste var blottelsen til højre for midten.
The worst was the exposure to the right of the middle.

Det er Johansen og Ottesen til højre i billedet.
It is Johansen and Ottesen to the right in the picture.

Det er den største og flotteste til højre i billedet.
It is the biggest and finest to the right in the picture.

Der sidder en bille til venstre på bladet.
There is a beetle to the left on the leaf.

Den er lille og billig til glæde for kunden.
It is small and cheap to the customer's benefit.

Der ligger en flitte til venstre på bordet.
There is a fleam to the left on the table.

Han er nøjsom og flittig til glæde for konen.
He is modest and diligent to his wife's pleasure.

(2)

Han begynder at pukle til ære for chefen.
He begins to slog away to please his boss.

Han begynder at gafle til maden igen.
He begins to pinch at his food again.

Hun elsker den gamle soldat med sablen.
She loves the old soldier with the sword.

Han prøver at padle til festen på øen.
He tries to paddle to the party on the island.

De begynder at mugne til vinter igen.
They begin to moulder in the winter again.

De begynder at visne til sommer igen.
They begin to wither in the summer again.

Den begyndte at bulne til aften igen.
It began to swell in the evening again.

Han prøver at kærne til påske igen.
He tries to churn at Easter again.

Han prøver at vidne til fangernes fordel.
He tries to testify to the advantage of the prisoners.

Han begyndte at klatre på klippen igen.
He began to climb the cliff again.

Han prøver at ofre til guden igen.
He tries to sacrifice to the god again.

Hun elsker at tømre på huset i ferien.
She loves to do carpentry on her house during vacations.

Han prøver at baldre karaflen på bordet.
He tries to smash the carafe on the table.

Han begynder at bladre fra midten og ud.
He begins to turn over the leaves from the centre and outwards.

Det ligner en pukkel til højre for bjerget.
It looks like a hump to the right of the mountain.

Han bruger sin gaffel til andet end spisning.
He uses his fork for other things than eating.

Han ligner en gammel soldat fra ryggen.
He looks like an old soldier from the back.

Han henter en saddel til hesten i boksen.
He fetches a saddle for the horse in the loosebox.

Den er gammel og muggen til vinter igen.
It is old and mouldy in the winter again.

Den er gammel og vissen til sommer igen.
It is old and withered in the summer again.

Den er rødlig og bullen til aften igen.
It is red and swollen in the evening again.

Han sidder på kærren til venstre for kusken.
He sits on the cart to the left of the coachman.

Han bruger sin viden til fangernes fordel.
He uses his knowledge to the advantage of the prisoners.

Han sidder og klatter på dugen igen.
He is blotting the tablecloth again.

Han bringer et offer til guden igen.
He is sacrificing to the god again.

Han sidder og tømmer ballonen med håndkraft.
He is emptying the balloon by hand.

Han sidder og kalder på barnet i sengen.
He is calling the child in the bed.

Han prøver med kladder fra starten igen.
He tries with drafts from the start again.

(3)

Han begyndte at bande til skræk for sin kone.
He began to swear to his wife's alarm.

Det er den bedste bane til brug for galoppen.
It is the best track for the gallop.

Han henter en kande til mælken og fløden.
He fetches a jug for the milk and the cream.

Hun købte en kane til pigernes heste.
She bought a sleigh for the girls' horses.

Det blev regn og kulde til galoppen iår.
It was rainy and cold at the gallop this year.

Han støbte en kugle til kanonen igår.
He cast a ball for the cannon yesterday.

Det er bedre at skille til venstre igen.
It is better to divide on the left side again.

Han begyndte at skele til pigen igen.
He began squinting at the girl again.

De er gode og lune til brug i december.
They are good and warm for use in December.

Han sidder ved lugen til venstre for døren.
He is sitting in the hatch to the left of the door.

(4)

Der er flere skabe til pigernes tøj.
There are several closets for the girls' clothes.

Han sidder og skaber sig midt under festen.
He is putting on an act during the party.

Han begyndte at gyse på grund af historien.
He began to shudder on account of the story.

Det ligner en gyser på grund af plakaten.
It looks like a thriller to judge from the placard.

Forløbet skal stoppe så tidligt som muligt.
The course of events must be stopped as soon as possible.

Han bremser og stopper så tidligt som muligt.
He brakes and stops as soon as possible.

Han ryger et stop så tidligt som muligt.
He smokes a fill as early as possible.

Façonen skal passe til formålet.
The shape should match the purpose.

Han bruger en passer til tegningen.
He uses calipers for the drawing.

Han henter et pas til formanden.
He fetches a passport for the foreman.

APPENDIX III

In tables I-X the words in figure 1-4 are categorized according to the location of their Fo maximum (A) in the first post-tonic syllable, (B) between the first and second post-tonics and (C) in the second post-tonic syllable. The number of words in each category is listed for each subject and subjects' total. The distribution of the words in the three categories is compared across words with different segmental structure: The data may meet the requirements for a χ^2 test on the basis of a 3x2 contingency table or they may only meet the requirements for a χ^2 test on the basis of a 2x2 contingency table, cf. Siegel (1956). If χ^2 is not applicable in the 2x2 case either, the Fischer exact probability test is applied. p is given if smaller than 0.05.

Table I

Distribution of words according to the location of the Fo maximum. All words in the material are included. See further the introduction to appendix III.

	A	B	C	total
NRP	50	13	10	73
JR	66	8	0	74
BH	16	26	29	71
NT	29	24	20	73
total	161	71	59	

Table II

Distribution of words according to the location of the Fo maximum. Words from part (1) of the material, frames 1-7 in figure 1-4: words with [i] in the first post-tonic (left), with [ə] (mid) and with a syllabic consonant (right). See further the introduction to appendix III.

	[i]			[ə]			[ç̩]		
	A	B	C	A	B	C	A	B	C
NRP	2	0	0	5	3	0	3	3	5
JR	2	0	0	7	1	0	8	3	0
BH	0	2	0	1	5	2	0	3	7
NT	0	2	0	2	1	4	2	4	5
total	4	4	0	15	10	6	13	13	17

Table III

Distribution of words according to the location of the Fo maximum. All words in the material are included: words with a vowel other than [ə] in the first post-tonic syllable (left), with [ə] (mid) and words with a syllabic consonant (right). See further the introduction to appendix III.

	Vowel other than [ə]			[ə]				[C̩]		
	A	B	C	A	B	C		A	B	C
NRP	18	1	1	14	3	0		18	9	5
JR	20	0	0	17	1	0		28	4	0
BH	3	10	7	7	5	4	$p<0.05$	4	13	15
NT	8	8	3	5	3	5		14	15	8
total	49	19	11	43	12	9	$p<0.01$	64	41	28

Table IV

Distribution of words according to the location of the Fo maximum. All words in the material are included: words with a vowel in the first post-tonic syllable (left), and words with a syllabic consonant (right). The left block of data is a summation of the left and mid blocks of table III. See further the introduction to appendix III.

	[V]				[C̩]		
	A	B	C		A	B	C
NRP	32	4	1	$p<0.01$	18	9	5
JR	37	1	0		28	4	0
BH	10	15	11		4	13	15
NT	13	11	8		14	5	8
total	92	31	20	$p<0.025$	64	41	28

Table V

Distribution of words according to the location of the Fo maximum. Trisyllabic words from part (1c) of the material (frame 6-7 in figure 1-4): words with [ə] in the first post-tonic syllable (left) and words with syllabic [l̩] (right). See further the introduction to appendix III.

	[ə]			[C̩]		
	A	B	C	A	B	C
NRP	2	2	0	1	1	2
JR	4	0	0	3	1	0
BH	0	3	1	0	3	0
NT	0	1	2	1	1	2
total	6	6	3	5	6	4

Table VI

Distribution of words according to the location of the Fo maximum. Words ending in [-V·C̩(s)] or [-VV̯C̩] versus [-VC̩(s)] ([C] = [l n]): *males, banes, mades, kærne, bane, kane, kugle, skele, lune* versus *tælles, kendes, loddes, bille, saddel, bande, kande, kulde, skille*). See further the introduction to appendix III.

	[-V·C̩(s)]			[-VC̩(s)]		
	A	B	C	A	B	C
NRP	6	2	1	2	5	2
JR	8	1	0	7	2	0
BH	0	3	6	0	0	9
NT	1	6	2	1	5	3
total	15	12	9	10	12	14

Table VII

Distribution of words according to the location of the Fo maximum. Words with a syllabic consonant in the first post-tonic syllable after a (long or short) vowel or diphthong versus a consonant (*males, banes, mades, tælles, kendes,loddes, bille, saddel, kærne, viden, lune, bane, bande, kane, kande, kugle, kulde, skele, skille* versus *tykkelse, tykkelsen, blottelse, blottelsen, pukle, pukkel, gafle, gaffel, gamle, gammel, padle, mugne, muggen, visne, vissen, bulne, vidne*). See further the introduction to appendix III.

	[-V(·)C̩(C)]				[-VCC̩]		
	A	B	C		A	B	C
NRP	9	7	3		8	2	2
JR	16	3	0		10	1	0
BH	0	4	15	$p<0.0005$	2	10	0
NT	3	11	5	$p<0.001$	10	4	3
total	28	25	23	$p<0.001$	30	17	5

Table VIII

Distribution of words according to the location of the Fo maximum. Words ending in /-Cəl/ and /-Cən/ versus /-Clə/ and /-Cnə/ (*pukkel, gaffel, gammel, muggen, vissen,* versus *pukle, gafle, gamle, padle, mugne, visne, bulne, vidne*), where /ə/ is assimilated in the /-CəC/ type (left), where [ə] is pronounced in the /-CCə/ type (mid), and where /ə/ is assimilated in the /-CCə/ type (right). See further the introduction to appendix III.

	[C̩] /-CəC/			[ə] /-CCə/			[C̩] /-CCə/		
	A	B	C	A	B	C	A	B	C
NRP	5	0	0	6	0	0	2	1	0
JR	5	0	0	6	0	0	3	0	0
BH	2	3	0	4	0	0	1	3	0
NT	2	2	1	1	1	0	7	1	0
total	14	5	1	17	1	0	13	5	0

Table IX

Distribution of words according to the location of the Fo maximum. Words ending in /-Crə/ versus /-Cər/ (*klatre, ofre, tømre, baldre, bladre* versus *klatter, offer, tømmer, kalder, kladder*), where [ʁ] is pronounced in the /-Crə/ type (left), where /r/ is vocalized in the /-Crə/ type (mid), and where /r/ is vocalized in the /-Cər/ type (right). See further the introduction to appendix III.

	[ʁʌ] /-Crə/			[C·ʌ] /-Crə/			[Cʌ] /-Cər/		
	A	B	C	A	B	C	A	B	C
NRP	3	0	0	2	0	0	3	1	1
JR	1	0	0	4	0	0	5	0	0
BH	1	2	1	0	1	0	0	3	2
NT	0	0	1	3	1	0	3	1	1
total	5	2	2	9	2	0	11	5	4

Table X

Distribution of words according to the location of the Fo maximum. 45 (left) and 6 (right) polysyllabic words whose Swedish counterparts have Accent II and Accent I, respectively. Two different pronunciations of the same phonological word count as two words here, which is why individual totals do not add up to 45 and 6, respectively. See further the introduction to appendix III.

	"Accent II"			"Accent I"		
	A	B	C	A	B	C
NRP	33	8	7	5	1	1
JR	44	5	0	6	1	0
BH	8	16	22	2	3	2
NT	18	17	10	3	2	2
total	103	46	39	16	7	5

APPENDIX IV

In table XI-XVI the average duration in centiseconds (mean of means) of the stressed and first post-tonic syllable is given for various groups or pairs of words. Duration is measured from the onset of the stressed vowel to the offset of voicing in the post-tonic. Standard deviations on means, s, are given as well as the number of items, N, behind each mean. Tests of significance (student's one-tailed t-test) between means in different columns (table XI-XV) or between word pairs (table XVI) have been performed, and *p* is given if smaller than 0.05.

Table XI

Average duration of the stressed and first post-tonic syllable in words grouped according to the location of the Fo maximum (A) in the first post-tonic syllable, (B) between the first and second post-tonic syllables, and (C) in the second post-tonic syllable. See further the introduction to appendix IV.

		A	B	C	
NRP	$\bar{X}$ =	25.0 cs	23.7 cs	17.2 cs	A>B: not sign.
	s =	3.12 -	3.11 -	3.40 -	B>C: p<0.0005
	N =	50	12	10	A>C: p 0.0005
JR	$\bar{X}$ =	20.2 cs	14.1 cs		A>B: p<0.0005
	s =	3.76 -	2.81 -		
	N =	66	8		
BH	$\bar{X}$ =	24.9 cs	21.3 cs	20.3 cs	A>B: p<0.0005
	s =	2.23 -	3.59 -	4.23 -	B>C: not sign.
	N =	16	25	29	A>C: p<0.0005
NT	$\bar{X}$ =	27.1 cs	24.8 cs	21.0 cs	A>B: p<0.05
	s =	4.99 -	3.42 -	4.33 -	B>C: p<0.005
	N =	26	25	20	A>C: p<0.0005

Table XII

Average duration of the stressed and first post-tonic syllable in the two groups of words in table VI. See further the introduction to appendix IV.

		[-V·C̣(s)]		[-VC̣(s)]
NRP	$\bar{X}$ =	26.6 cs	p<0.005	22.5 cs
	s =	3.15 -		2.70 -
	N =	9		9
JR	$\bar{X}$ =	20.7 cs	p<0.025	16.9 cs
	s =	4.75 -		3.39 -
	N =	9		9
BH	$\bar{X}$ =	22.0 cs		20.8 cs
	s =	3.22 -		3.34 -
	N =	9		9
NT	$\bar{X}$ =	26.5 cs		23.8 cs
	s =	3.47 -		3.39 -
	N =	9		9

Table XIII

Average duration of the stressed and first post-tonic syllable in the two groups of words in table VII. See further the introduction to appendix IV.

		[-V(·)C̣(C)]		[-VCC̣]
NRP	$\bar{X}$ =	24.6 cs		24.9 cs
	s =	3.49 -		3.0 -
	N =	19		12
JR	$\bar{X}$ =	18.9 cs		19.5 cs
	s =	4.33 -		2.65 -
	N =	19		11
BH	$\bar{X}$ =	20.4 cs	p<0.005	24.4 cs
	s =	5.47 -		2.45 -
	N =	19		12
NT	$\bar{X}$ =	25.1 cs		27.2 cs
	s =	3.52 -		4.47 -
	N =	19		17

Table XIV

Average duration of the stressed and first post-tonic syllable in the three groups of words in table VIII. See further the introduction to appendix IV.

		a	b	c	
		[C̩] /-CəC/	[ə] /-CCə/	[C̩] /-CCə/	
NRP	$\bar{X}$ =	25.4 cs	26.0 cs	27.2 cs	
	s =	1.97 -	1.60 -		
	N =	5	6	3	
JR	$\bar{X}$ =	20.8 cs	23.6 cs	20.5 cs	b>a: $p<0.025$
	s =	2.15 -	1.61 -		
	N =	5	6	3	
BH	$\bar{X}$ =	25.1 cs	25.4 cs	25.3 cs	
	s =	1.79 -	1.34 -		
	N =	5	4	3	
NT	$\bar{X}$ =	26.3 cs	29.2 cs	30.2 cs	c>a: $p<0.025$
	s =	1.66 -		3.91 -	
	N =	5	2	8	

Table XV

Average duration of the stressed and first post-tonic syllable in the three groups of words in table IX. See further the introduction to appendix IV.

		a	b	c	
		[ʁʌ] /-Crə/	[C·ʌ] /-Crə/	[Cʌ] /-Cər/	
NRP	$\bar{X}$ =	26.0 cs	24.5 cs	21.1 cs	
	s =			1.54 -	
	N =	3	2	5	
JR	$\bar{X}$ =	25.3 cs	22.0 cs	20.0 cs	
	s =		3.05 -	3.09 -	
	N =	1	4	5	
BH	$\bar{X}$ =	23.4 cs	22.7 cs	20.3 cs	a>c: $p<0.025$
	s =	1.53 -		3.33 -	
	N =	4	1	5	
NT	$\bar{X}$ =	24.9 cs	26.1 cs	23.1 cs	
	s =		3.49 -	1.69 -	
	N =	1	4	5	

Table XVI

Average duration of the stressed and post-tonic syllable(s) in words with a pairwise comparable segmental structure <u>and</u> a difference in Fo peak location: (A) in the first post-tonic, (B) between the first and second post-tonic, and (C) in the second post-tonic syllable. Duration from stressed vowel onset till the offset of voicing in the second post-tonic is given when one word in a pair has the peak located in the second post-tonic. See further the introduction to appendix III.

NRP			$\bar{X}$	s	N	
mases	(A)	[æ·sə]	27.8 cs	1.14 cs	5	p<0.0005
males	(B)	[æ·l̩]	23.0 -	1.00 -	5	
tættes til	(B)	[ɛd̥əs d̥ˢe]	39.5 -	1.22 -	6	p<0.0005
tælles til	(C)	[ɛll̩s d̥ˢe]	36.3 -	0.52 -	6	
bane	(A)	[æ·n̩]	29.7 -	1.21 -	6	p<0.0005
bande	(B)	[ann̩]	26.0 -	0.63 -	6	
kane	(A)	[æ·n̩]	31.0 -	1.26 -	6	p<0.0005
kande	(B)	[ann̩]	25.2 -	0.75 -	6	
kugle	(A)	[u·l̩]	25.6 -	0.89 -	5	p<0.0005
kulde	(B)	[ull̩]	21.4 -	1.14 -	5	
JR						
tættes	(A)	[ɛd̥ə]	13.4 -	1.14 -	5	not sign.
tælles	(B)	[ɛll̩]	13.3 -	0.81 -	6	
kugle	(A)	[u·l̩]	16.6 -	0.55 -	5	p<0.0005
kulde	(B)	[ull̩]	13.3 -	0.52 -	6	
BH						
mases med	(A)	[æ·sə]	39.0 -	2.71 -	4	p<0.025
males med	(C)	[æ·l̩]	34.7 -	2.73 -	6	
bille til	(C)	[ill̩ d̥ˢe]	28.7 -	1.86 -	6	not sign.
billig til	(B)	[ili d̥ˢe]	29.4 -	0.89 -	5	
pukle	(A)	[ɔg̊lə]	23.7 -	0.52 -	6	p<0.05
pukkel	(B)	[ɔg̊l̩]	22.5 -	1.38 -	6	
kærne til	(B)	[æʌ̆n̩ d̥ˢe]	34.7 -	4.72 -	6	not sign.
kærren til	(C)	[æʌ̆ʌn d̥ˢe]	37.2 -	2.99 -	6	

(continued)

(Table XVI continued)

NT			$\bar{X}$	s	N	
gafle	(A)	[ɑf·ḷ]	33.9 cs	2.28 cs	10	p<0.0005
gaffel	(B)	[ɑfḷ]	27.3 -	0.95 -	10	
mugne	(A)	[ɔg̊·ṇ]	33.3 -	1.58 -	9	p<0.0005
muggen	(B)	[ɔg̊ŋ̣]	26.7 -	0.82 -	10	
kærne til	(B)	[æʌ̆ṇ d̥ˢe]	41.5 -	1.72 -	10	p<0.005
kærren til	(C)	[æʌ̆ʌn d̥ˢe]	38.9 -	1.52 -	10	
bane	(A)	[æ·ṇ]	30.1 -	0.99 -	10	p<0.01
bande	(B)	[anṇ]	28.7 -	1.25 -	10	

Table XVII

Pearson Product Moment Correlations (r) between the height of the rise (in Hz) from the Fo minimum in the stressed vowel and the duration (in centiseconds) of this rise. The slope (Hz/cs) of the least squares regression line, the number of data pairs, N, in the calculations and t and p are given.

		NRP	JR	BH	NT
r	=	0.94	0.78	0.90	0.81
Slope	=	1.98	1.43	2.46	2.21
N	=	53	58	56	52
t	=	19.5	9.37	15.4	9.72
p	<	0.0005	0.0005	0.0005	0.0005

APPENDIX V

In table XVIII-XX the duration (in centiseconds) of vowels and consonants in the word pairs of parts (3), (4) and (2) of the material is listed. Standard deviations, s, and the number of items, N, behind each mean are given. Tests of significance (student's t-test) have been performed, and *p* is indicated if smaller than 0.05.

Table XVIII

Average duration of the long and short vowel and the syllabic consonant in the words of part (3) of the material. Vowel and consonant could not always be separated, and their summed value is given.

		V	C	V+C
NRP				
bane/bande	$\bar{X}$ =	18.2/11.7	11.5/14.3	29.7/26.0 cs
N= 6/6	s =	0.75/1.03	1.38/0.82	1.21/0.63 cs
	p <	0.0005	0.005	0.0005
kane/kande	$\bar{X}$ =	19.2/10.5	11.8/14.7	31.0/25.2 cs
N= 6/6	s =	0.98/0.84	0.75/0.52	1.26/0.75 cs
	p <	0.0005	0.0005	0.0005
kugle/kulde	$\bar{X}$ =	16.8/10.2	8.8/11.2	25.6/21.4 cs
N= 5/5	s =	0.84/0.84	0.84/0.45	0.89/1.14 cs
	p <	0.0005	0.0005	0.0005
skele/skille	$\bar{X}$ =	17.0/ 9.3	8.5/11.7	25.5/21.0 cs
N= 6/6	s =	1.10/0.52	1.22/0.82	1.87/1.10 cs
	p <	0.0005	0.0005	0.0005
JR				
bane/bande	$\bar{X}$ =	16.7/12.3	7.3/ 8.5	24.0/20.8 cs
N= 6/6	s =	0.82/0.82	0.52/1.38	0.63/1.47 cs
	p <	0.0005	0.05	0.0005
kane/kande	$\bar{X}$ =	15.7/10.5	7.5/ 8.2	23.2/18.7 cs
N= 6/6	s =	1.03/1.38	0.84/1.60	0.75/0.82 cs
	p <	0.0005	-	0.0005
kugle/kulde	$\bar{X}$ =			16.6/13.3 cs
N= 5/6	s =			0.55/0.52 cs
	p <			0.0005
skele/skille	$\bar{X}$ =	12.2/ 7.0	4.6/ 6.8	16.8/13.8 cs
N= 5/6	s =	1.64/0.89	1.14/0.98	2.28/1.17 cs
	p <	0.0005	0.0005	0.025

(continued)

(Table XVIII continued)

			V	C	V+C
BH					
	bane/bande	$\bar{X}$ =	17.0/13.5	7.0/11.5	24.0/25.0 cs
	N= 5/6	s =	1.22/1.05	1.22/0.84	1.87/1.41 cs
		p <	0.0005	0.0005	-
	kane/kande	$\bar{X}$ =	17.3/12.8	8.0/12.7	25.3/25.5 cs
	N= 6/6	s =	1.97/0.41	1.67/1.97	2.88/2.17 cs
		p <	0.0005	0.005	-
	kugle/kulde	$\bar{X}$ =	/8.8	/8.6	17.7/17.4 cs
	N= 6/5	s =	/0.84	/0.89	1.37/0.89 cs
		p			-
	skele/skille	$\bar{X}$ =	14.0/ 9.0	5.2/ 8.5	19.2/17.5 cs
	N= 6/5	s =	0.63/0.89	0.98/1.05	1.60/1.87 cs
		p <	0.0005	0.0005	-
NT					
	bane/bande	$\bar{X}$ =	17.2/13.2	12.9/15.5	30.1/28.7 cs
	N= 10/10	s =	1.23/0.92	1.29/0.97	0.99/1.25 cs
		p <	0.0005	0.0005	0.01
	kane/kande	$\bar{X}$ =	17.7/13.8	12.8/14.1	30.5/27.9 cs
	N= 10/10	s =	0.95/0.92	1.14/0.99	1.51/1.10 cs
		p <	0.0005	0.01	0.0005
	kugle/kulde	$\bar{X}$ =	13.8/ 8.6	9.8/13.7	23.6/22.6 cs
	N= 10/10	s =	1.14/0.70	0.79/1.25	0.97/1.16 cs
		p <	0.0005	0.0005	0.05
	skele/skille	$\bar{X}$ =	14.0/ 9.1	10.2/12.5	24.2/21.6 cs
	N= 10/10	s =	0.82/0.74	1.03/0.97	1.23/0.70
		p <	0.0005	0.0005	0.0005

Table XIX

Average duration of selected segments in the word pairs of part (2) of the material. If a subject's pronunciation deviates from the maximally reduced one in the /-CCə/ type it is noted to the right of subjects' initials, cf. appendix I (2). If a word is pronounced in two ways, only the maximally reduced one is included here. See further the introduction to appendix V.

(a)

pukle/pukkel		[ɔ]	[g̊]	[l̩]	[lə]
NRP [ə]	$\bar{X}$ =	10.0/11.3	10.3/6.8	/5.2	4.5/
N= 6/6	s =	0.63/0.82	2.42/1.17	/0.75	1.52/
	p <	0.01	0.005		
JR [ə]	$\bar{X}$ =	7.2/7.3	8.3/5.0	/6.2	6.3/
N = 6/6	s =	0.41/0.82	0.82/0.00	/0.41	0.52/
	p <		0.0005		
BH [ə]	$\bar{X}$ =	8.3/10.8	10.7/5.7	/6.0	4.7/
N= 6/6	s =	1.21/1.34	1.21/0.82	/1.10	0.52/
	p <	0.005	0.0005		
NT	$\bar{X}$ =	11.5/10.8	8.4/6.7	9.4/7.0	
N=10/10	s =	0.97/0.63	1.17/0.82	1.84/1.33	
	p <	0.05	0.0005	0.005	

gafle/gaffel		[ɑ]	[fl]	[f]	[l̩]
NRP [ə]	$\bar{X}$ =	13.3/14.3	12.6/12.8	/8.3	/4.5
N= 5/6	s =	0.52/0.52	0.55/0.75	/1.21	/1.05
	p <	0.005			
JR [ə]	$\bar{X}$ =	10.1/10.8	8.9/11.0	/5.8	/5.2
N= 7/6	s =	0.69/0.75	1.21/0.63	/0.75	/0.75
	p <		0.005		
BH [ə]	$\bar{X}$ =	11.8/15.0	12.6/11.7	/5.7	/6.0
N= 5/6	s =	1.64/1.10	2.61/2.07	/0.52	/2.19
	p <	0.005			
NT	$\bar{X}$ =	14.4/12.9		11.1/9.2	8.4/5.2
N=10/10	s =	0.84/0.88		0.57/1.23	1.84/0.79
	p <	0.005		0.0005	0.0005

(continued)

(Table XIX continued)

gamle/gammel		[ɑ]	[mḷ]		[ɑmḷ]
NRP	$\bar{X}$ =	/12.7	/11.0		25.2/23.7
N= 6/6	s =	/0.82	/0.63		1.76/1.21
	p <				0.05
JR	$\bar{X}$ =	9.0/9.2	9.7/9.2		18.7/18.3
N= 6/6	s =	0.89/0.41	1.37/0.98		1.03/0.82
	p <				
BH	$\bar{X}$ =	11.6/11.5	11.4/12.7		23.0/24.2
N= 5/6	s =	1.14/0.55	0.55/1.51		1.00/1.47
	p <		0.05		
			[m]	[ḷ]	
NT	$\bar{X}$ =	12.3/12.0	7.4/7.0	7.6/5.8	27.3/24.8
N= 8/10	s =	0.46/0.47	1.06/1.33	1.77/1.03	1.28/1.03
	p <			0.025	0.0005
padle/saddel		[að]	[l]	[aðl]	
NRP	$\bar{X}$ =			27.5/25.2	
N= 6/6	s =			1.38/0.55	
	p <			0.005	
JR	$\bar{X}$ =	15.4/17.5	7.4/5.2		
N= 5/6	s =	0.55/1.38	0.89/0.75		
	p <	0.005	0.005		
BH [ə]	$\bar{X}$ =	16.8/18.2	3.8/5.2		
N= 4/6	s =	1.26/1.94	0.96/0.75		
	p <		0.025		
NT	$\bar{X}$ =	19.4/19.6	10.8/5.1		
N=10/10	s =	1.26/1.43	1.14/1.10		
	p <		0.0005		

(b)

mugne/muggen		[ɔ]	[g̊]	[nə]	[ṇ/ŋ̣]
NRP [ə]	$\bar{X}$ =	10.8/12.0	9.8/7.0	6.3/	/6.3
N= 6/6	s =	1.17/1.79	1.17/0.89	1.51/	/1.03
	p <		0.0005		
JR [ə]	$\bar{X}$ =	8.8/8.8	9.3/6.5	7.5/	/7.2
N= 6/6	s =	0.98/0.75	1.03/1.22	0.84/	/1.17
	p <		0.005		
BH	$\bar{X}$ =	9.6/9.5	8.8/8.3		8.2/7.7
N= 5/6	s =	1.14/1.38	1.30/1.03		1.03/1.03
	p <				
NT	$\bar{X}$ =	11.0/9.9	9.7/8.1		12.7/8.7
N= 9/10	s=	0.87/0.74	1.12/0.88		1.50/0.82
	p <	0.005	0.005		0.0005

(continued)

(Table XIX continued)

visne/vissen		[e]	[s]	[nə]	[n̩]
NRP	$\bar{X}$ =	10.3/9.7	11.7/11.3		6.7/6.7
N= 3/6	s =	- /0.52	- /1.75		- /1.03
	p <				
JR [ə]	$\bar{X}$ =	8.5/7.7	10.3/9.2	5.8/	/5.8
N= 6/6	s =	0.55/1.03	0.52/1.17	0.75/	/0.75
	p <		0.05		
BH	$\bar{X}$ =	8.8/9.8	11.7/10.0		6.8/6.8
N= 6/6	s =	1.33/0.41	1.51/1.79		1.60/1.60
	p <				
NT	$\bar{X}$ =	10.4/10.0	12.7/11.5		11.1/6.9
N=10/10	s =	0.84/0.67	1.06/0.71		2.42/1.20
	p <		0.005		0.0005
bulne/bullen		[u]	[l]	[n]	[lnə]
NRP [ə]	$\bar{X}$ =	11.0/9.3	/11.8	/7.2	14.0/
N= 5/6	s =	1.41/1.21	/1.60	/1.72	1.41/
	p <	0.025			
		[ulnə/ul̩n]			
JR [ə]	$\bar{X}$ =	24.4/22.5			
N= 5/6	s =	1.14/1.38			
	p <	0.025			
		[u]	[l]	[uln]	
BH [ə]	$\bar{X}$ =	10.3/	10.5/	20.8/27.5	
N= 6/6	s =	1.75/	2.81/	1.47/1.87	
	p <			0.0005	
NT	$\bar{X}$ =	11.0/10.2	25.8/21.7		
N= 5/10	s =	0.71/0.92	1.48/1.57		
	p <	0.05	0.0005		
vidne/viden		[iðnə/iðn̩]			
NRP [ə]	$\bar{X}$ =	24.2/26.7			
N= 5/6	s =	1.30/2.25			
	p <	0.025			
		[ið]	[n]		
JR	$\bar{X}$ =	12.7/15.2	7.3/4.0		
N= 3/6	s =	- /1.47	- /0.63		
	p <				
BH	$\bar{X}$ =	11.8/14.2	12.2/9.8		
N= 6/6	s =	1.72/1.33	2.93/1.17		
	p <	0.025	0.05		
NT	$\bar{X}$ =	15.5/18.2	15.2/6.0		
N=10/10	s =	1.35/0.79	1.03/0.67		
	p <	0.0005	0.0005		

(continued)

(Table XIX continued)

kærne/kærren		[æƛ(ʌ)]	[n]
NRP	$\bar{X}$ =	15.5/20.0	12.8/6.2
N= 6/6	s =	0.55/1.79	1.17/0.75
	p <	0.0005	0.0005
JR	$\bar{X}$ =	14.3/17.5	5.5/3.5
N= 6/6	s =	1.63/1.05	0.55/0.55
	p <	0.005	0.0005
BH	$\bar{X}$ =	16.5/21.5	9.7/6.7
N= 6/6	s =	1.38/1.38	2.34/0.82
	p <	0.0005	0.005
NT	$\bar{X}$ =	16.4/21.4	14.7/5.0
N=10/10	s =	0.84/0.84	1.34/0.82
	p <	0.0005	0.0005

(c)

klatre/klatter		[a]	[d̥]
NRP [ʁ]	$\bar{X}$ =	10.2/11.3	12.0/4.3
N= 6/6	s =	0.41/0.82	1.26/1.03
	p <	0.01	0.0005
JR	$\bar{X}$ =	9.0/10.2	8.0/4.3
N= 6/6	s =	0.00/0.75	0.89/0.82
	p <	0.005	0.0005
BH [ʁ]	$\bar{X}$ =	9.5/9.3	11.3/3.7
N= 6/6	s =	1.22/1.63	1.03/0.82
	p <		0.0005
NT	$\bar{X}$ =	11.8/12.7	6.4/4.0
N=10/10	s =	0.42/0.48	0.70/0.82
	p <	0.005	0.0005

ofre/offer: the stressed vowel could not be segmented from the preceding sound in *ofre*; three subjects pronounced the [ʁ] which was devoiced and could not be reliably segmented from the preceding [f].

		[f]
NT	$\bar{X}$ =	12.4/9.9
N=10/10	s =	1.43/0.88
	p <	0.0005

(continued)

(Table XIX continued)

tømre/tømmer		[œ]	[m]
NRP	$\bar{X}$ =	8.8/7.8	6.6/5.0
N= 5/6	s =	0.84/0.98	0.89/0.89
	p <		0.01
JR	$\bar{X}$ =	6.5/6.5	6.7/5.2
	s =	0.55/0.84	0.52/0.41
	p <		0.0005
BH [ʁ]	$\bar{X}$ =	6.5/5.5	8.4/7.5
N= 6/6	s =	0.55/1.22	1.34/ -
	p <		
NT [ʁ]	$\bar{X}$ =	8.5/6.4	7.3/6.9
N=10/10	s =	0.71/0.52	0.82/0.74
	p <	0.0005	

baldre/kalder		[a]	[ɪ]	[ɪʌ]
NRP [ʁ]	$\bar{X}$ =	10.3/10.2	7.3/4.6	
N= 6/5	s =	0.52/0.45	1.03/0.55	
	p <		0.0005	
JR	$\bar{X}$ =	10.9/10.2		15.6/4.3
N= 7/6	s =	0.69/0.75		1.13/0.52
	p <			
BH [ʁ]	$\bar{X}$ =	11.3/10.8	5.8/5.3	
N= 6/6	s =	1.21/0.75	0.96/0.52	
	p <			
NT	$\bar{X}$ =	10.2/10.6	7.5/5.2	
N=10/10	s =	0.61/0.97	0.97/0.79	
	p <		0.0005	

bladre/kladder		[aðʌ]
NRP	$\bar{X}$ =	26.0/22.3
N= 6/6	s =	1.26/0.82
	p <	0.0005
JR	$\bar{X}$ =	20.5/20.8
N= 6/6	s =	0.55/1.47
	p <	
BH	$\bar{X}$ =	22.7/22.2
N= 6/6	s =	1.63/1.72
	p <	
NT	$\bar{X}$ =	28.8/25.0
N=10/10	s =	1.62/1.25
	p <	0.0005

Table XX

Average duration of the stressed vowel and postvocalic consonant in the words of part (4) of the material. *skabe̸* was followed by *til* and [b̥d̥^{s}] could not be separated. See further the introduction to appendix V. For reasons of clarity *p* is given only for the comparisons between words with elided schwa and disyllabic words. The Fo rise in the stressed vowel (in semitones per second) is given to the right.

	V $\bar{X}$ / s /N		C $\bar{X}$ / s /N		Fo rise in semitones/second
NRP					
skabe	18.0/0.82/4		3.8/0.96/4		20
skabe̸	15.3/ - /3		-		33
skaber	15.3/0.82/6		6.2/2.23/6		15
gyse	13.8/0.50/4		8.0/ - /3		4
gyse̸	14.0/0.82/4		6.3/0.96/4	$p<0.005$	29
gyser	13.5/1.38/6		9.0/1.26/6		18
stoppe	14.3/ - /3		5.0/ - /3		9
stoppe̸	12.5/0.58/4		6.5/0.58/4		32
stopper	13.7/1.03/6		6.3/1.37/6		4
stop	10.8/0.75/6		5.5/1.05/6		43
passe̸	12.2/0.75/6	$p<0.025$	5.7/0.52/6		18
passer	13.5/1.05/6		7.7/0.82/6		23
pas	11.3/0.52/6		5.7/1.03/6		34
JR					
skabe	13.8/0.50/4		4.5/0.58/4		36
skabe̸	13.5/ - /2		-		31
skaber	11.7/0.52/6		4.7/0.52/6		53
gyse	9.8/1.26/4		9.3/0.50/4		7
gyse̸	9.5/ - /2		9.5/ - /2		20
gyser	9.0/0.00/6		7.3/1.03/6		-
stoppe	10.0/0.71/5		4.4/1.14/5		39
stoppe̸	10.0/ - /1		5.0/ - /1		50
stopper	9.0/0.89/6		4.8/0.98/6		-
stop	9.5/0.55/6		5.7/0.52/6		20
passe̸	11.7/1.21/6		5.0/0.63/6	$p<0.005$	21
passer	10.7/1.21/6		6.5/0.84/6		38
pas	9.2/1.17/6		4.7/0.82/6		16

(continued)

(Table XX continued)

	V $\bar{X}$ / s /N		C $\bar{X}$ / s /N		Fo rise in semi-tones/ second
BH					
skabe	15.0/1.22/5		5.0/0.71/5		23
skabe̸	13.5/ - /2				12
skaber	13.0/0.63/6		5.0/0.00/6		14
gyse	14.0/0.71/5	p<0.005	5.6/0.55/5		10
gyse̸	10.7/1.97/6		6.2/1.94/6		10
gyser	10.8/0.75/6		5.3/1.03/5		10
stoppe	13.6/1.14/5		-		16
stopper	13.0/1.26/6		5.2/0.45/5		12
stop	9.7/0.82/6		5.3/0.52/6		10
passe	10.3/ - /3		7.7/ - /3		-
passe̸	11.5/0.84/6		4.8/0.75/6	p<0.005	-
passer	10.3/1.37/6		7.0/1.10/6		-
pas	11.0/0.00/6		4.5/0.84/6		-
NT					
skabe	13.8/0.96/4	p<0.05	7.0/0.82/4		8
skabe̸	15.0/0.84/6	p<0.0005	-		20
skaber	11.3/0.82/10		8.0/0.82/10		15
gyse	14.3/ - /3		9.0/ - /3		2
gyse̸	13.3/1.89/7		8.3/0.49/7		16
gyser	11.5/0.85/10		9.0/1.05/10		-
stoppe	13.4/0.89/5		6.4/1.14/5		-
stoppe̸	12.2/1.64/5		8.0/2.35/5		-
stopper	11.4/0.52/10		7.2/0.63/10		6
stop	9.8/0.63/10		7.5/0.71/10		2
passe̸	15.0/0.94/10	p<0.0005	9.4/0.84/10	p<0.005	17
passer	13.1/0.74/10		8.4/0.70/10		7
pas	13.3/0.82/10		7.5/0.71/10		2