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STANDARD DANISH INTONATION*)

NINA GRØNNUM THORSEN

INTRODUCTION

By intonation I mean speech melody, i.e. the fundamental frequency (F_0) variation as it appears in F_0 curves from (analog or digital) frequency analysers. Other phenomena which in linguistic tradition are occasionally encompassed by intonation, such as rhythm and voice quality, will not be dealt with here.

The results which are summarized below derive from systematic, empirical acoustic investigations of the speech of a total of ten speakers. My investigations have had certain intrinsic limitations. They deal with utterances which have been read by the speakers in a sound treated room. The material is to a major extent composed of severely limited and manipulated utterance types, i.e. typical 'laboratory speech'. Such a procedure may seem inappropriate in view of the fact that the final goal is a description of the intonation of spontaneous speech. However, the method may be defended on at least two grounds. Firstly, it is convenient to investigate the course of F_0 in syntactically and pragmatically simple structures which have been produced under controlled circumstances, because this allows you to single out the parameter under scrutiny without interference from other factors which may influence F_0. Secondly, you may reasonably expect that natural, spontaneous speech can be described, at least to a certain extent, with the same categories and prosodic structures which have been discovered in edited, read speech. In other words, the intonation of free speech ought later to be accounted for with the same descriptional devices as the controlled speech situation, although you may find that the inventory of parameters will have to be supplemented.

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*) Contribution for a volume about intonation systems of various languages edited by Albert di Cristo and Daniel Hirst, to be published by Cambridge University Press.

HIERARCHIES IN DANISH INTONATION

It is my basic assumption that Standard Danish intonational phenomena are structured in a hierarchically organized system, where components of smaller temporal scope are superposed on components of larger temporal domain. Such an organization creates global tendencies with more local modifications. The following components can be discerned:

(1) the text contributes an overall textual contour

(2) the sentence/utterance yields a sentence intonation contour

(3) the prosodic phrase adds a phrasal contour

(4) the prosodic stress group (or foot) contributes a stress group pattern

(5) the 'stød' (see below) may involve a tonal modification of the stress group pattern

(6) individual segments have intrinsic F_0 characteristics (the microprosodic component).

These components are simultaneous, parametric, non-categorical and highly interacting in their actual production.

This view of intonation as a hierarchically organized, layered, system of components is not uncontroversial. Pierrehumbert 1980 and Liberman and Pierrehumbert 1984 take a different approach, and describe intonation in terms of a linear sequence of categorically different, non-interacting (high and low) tones. For a discussion of the relative merits of the two theories, see Ladd 1983a, 1983b, and Thorsen 1983a, 1983b, 1985, 1986, and 1987b.

Nos. (6) and (5) will not be dealt with any further in this chapter. The reader is referred to Thorsen 1979 and Fischer-Jørgensen 1987 for further treatment of microprosody and stød, respectively.

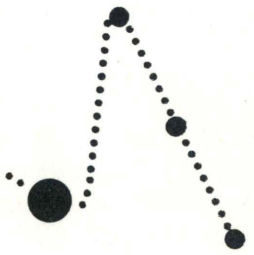
THE PROSODIC STRESS GROUP

Basbøll 1977 has defined a syntactic stress group in Danish as a group of words with one main stress, which is on the last word in the group (with certain exceptions - personal pronouns are unstressed even in stress group final position). The same definition is implicit in Andersen's 1954 description. The prosodic stress group, on the contrary, consists of a stressed syllable and all succeeding unstressed syllables (if any) - i.e. the prosodic stress group boundary, or foot boundary, lies immediately before the stressed syllable - independently of the number and type of syntactic boundaries in the utterance. The parsing of an utterance into prosodic stress groups can be illustrated with the following example (/ depicts the boundaries between two main clauses and between verb phrase and complement within each clause; + denotes prosodic stress group boundaries, and ´ marks the stressed syllables):

Han lagde sig / på chaiselongen / og tændte /
en Caminante.

Han + lágde sig på chaise + lóngen og + tændte
en Cami + nánte.

(He lay down on the sofa and lit a Caminante (a cheroot).)
The definition of the prosodic stress group as a stressed syllable plus all succeeding unstressed syllables (if any) within the same intonation contour derives from the analysis of tonal patterns. The prosodic stress group is the carrier of a recurring and fairly constant F_0 pattern consisting of a (relatively) low stressed syllable followed by a high-falling tail of unstressed syllables. Thus, the three capitalized sequences below are all realized with the same F_0 pattern:



HÁNDBOLDSPIL ER méget ánstrengende
baNÁNERNE I kássen er rådne
allerGÍ ER EN INfám sýgdom

(Handball-playing is very strenuous. The bananas in the box are rotten. Allergy is an infamous disease.)

The interesting fact here is the non-isomorphous relation between syntax and prosody (in casu: intonation). Somewhere in the speech production process the utterance is re-structured, whereby a considerable number of word- and higher syntactic boundaries are deleted in the course of F_0. (This is true at least of the type of monitored and fluently read speech which is the basis for the analysis.) See further Thorsen 1980a.

If tonal relations are accepted as criteria for locating boundaries, it is clear that the prosodic stress group cannot, e.g., end with the stressed syllable: the tonal relation between a stressed syllable and the preceding unstressed one is highly variable, as is apparent from figure 1. The preceding syllable may be higher than, on a level with, or lower than the stressed syllable, depending on how many unstressed syllables precede. I have not investigated rhythmic structure, nor have I looked at segmental cues to syntactic boundaries, and the general relevance in speech production and perception of the prosodic stress group as defined here must be corroborated by investigations of timing.

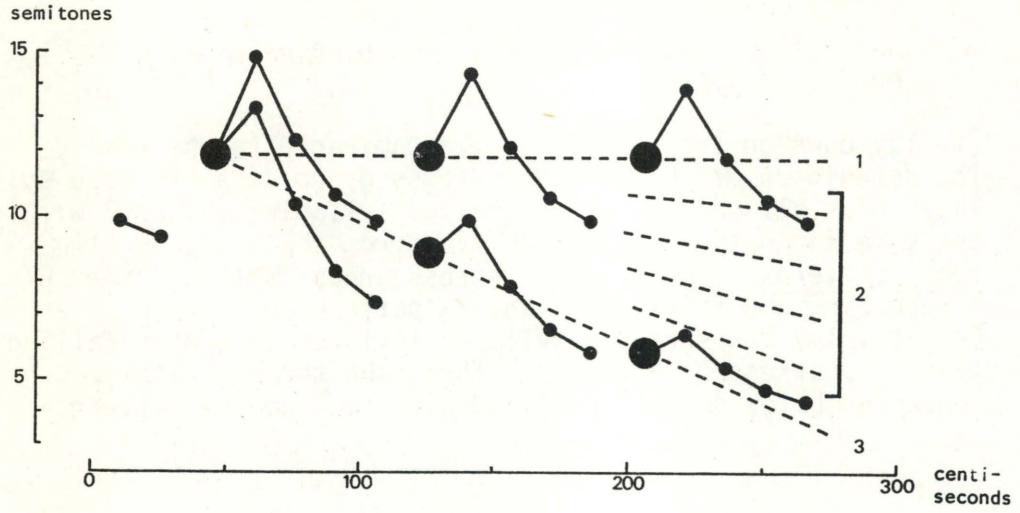


Figure 1

A model for the course of fundamental frequency in short sentences in Standard Danish. (1) Syntactically unmarked questions. (2) Questions with word order inversion and/or interrogative particle; non-final declarative and interrogative clauses. (3) Terminal declarative statements. Large points denote stressed syllables, small points depict unstressed syllables. Full lines represent the Fo pattern of prosodic stress groups; broken lines indicate the sentence intonation contours.

STRESS GROUP PATTERN VARIATION

The prosodic stress group pattern is subject to a certain quantitative variation, depending on

(1) its position in the utterance (the magnitude of the rise from stressed to post-tonic syllable decreases from beginning to end, ceteris paribus, cf. figure 1)

(2) the intonation upon which the pattern rides (the rise is higher on less falling contours, cf. figure 1)

(3) within the realm of non-emphatic, non-contrastive stress there is apparently a certain margin for varying the degree of relative prominence, which is proportional to the rise in F_0 from stressed to post-tonic syllable, cf. Thorsen 1987a.

Furthermore, the number of unstressed syllables in a prosodic stress group may vary between zero and rather large numbers, which naturally influences both the F_0 pattern and the time interval between the stressed syllables. If, e.g., there are no unstressed syllables in the stress group, there is no material on which the pattern can rise (and fall) , so the F_0 pattern is truncated (rather than being compressed in time to be contained within the single stressed syllable). Finally,

there is an interspeaker variation in the magnitude of the low-to-high interval and in the steepness of the slope of the falling unstressed syllables. See further Thorsen 1984a and 1984b.

ALIGNMENT OF SEGMENTS WITH F_0 PATTERNS

It is implicit in what has been said above, that Danish resembles the other Germanic languages where stress is concerned. I.e. stressed versus unstressed is a meaningful dichotomy in the phonology and phonetics of the language. Danish may even be an extreme case, when compared with its nearest (Swedish, Norwegian and German) neighbours where the reduction of unstressed syllables is concerned. Firstly, we have a vowel, /ə/, which is exclusive to unstressed syllables. Secondly, on the surface, in fluent speech, this vowel assimilates to a neighbouring sonorant consonant, to the effect that the only trace left of an unstressed syllable may be in (duration and) the course of F_0. See further Brink and Lund 1975 and Thorsen 1984a. (This rather drastic phonetic reduction - compared to the full underlying forms (and the orthographical representation) - contributes much to make Danish difficult to understand for Swedes and Norwegians, in spite of the obvious similarities between the Scandinavian languages.)

Danish has a phonological distinction in stressed syllables between long and short vowels, without the complementary consonantal length, characteristic of Standard Swedish and Norwegian. Stressed syllables also carry a phonologically relevant stød/non-stød distinction, corresponding to the word tone distinction of Swedish and Norwegian. However, the manifestation of the stød, which exhibits a good deal of dialectal and individual variation, is not generally considered to be primarily tonal. In Standard Danish it may be described as a kind of creaky voice which attacks the final part of a long vowel or the succeeding consonant, if the preceding vowel is short (see further Basbøll 1985, Fischer-Jørgensen 1987, and Gårding 1977). Stress and stød, both, are to a very large extent predictable from the segmental composition of the underlying lexical forms (cf. Basbøll 1972 and Rischel 1969).

To the extent that stød has an influence upon the course of F_0 it will generally introduce a local falling tonal movement. Stress has a much more invariable and considerable effect upon F_0, as can be inferred from the stylized model in figure 1. In Standard Danish the stress group is associated with a low + high-falling tonal pattern, whose trough is timed to coincide approximately with the offset of the stressed vowel, if it is short, or else about halfway through a long vowel, see the example in figure 2. The peak of the pattern is aligned with the first post-tonic syllable, in general. It is entirely possible to view the F_0 pattern associated with prosodic stress groups in Standard Danish as a basically time- and frequency invariant pattern: Segments and syllables

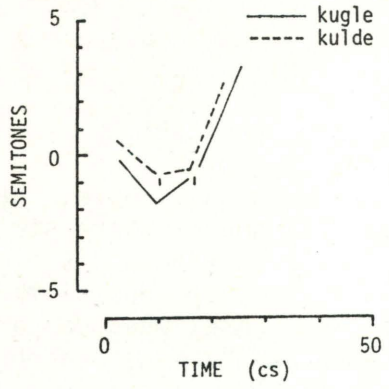


Figure 2

Fundamental frequency tracings (averages over 5 recordings) of two utterance medial words kugle and kulde [ˈkʰu.l, ˈkʰull]. The vowel-consonant boundary is indicated with a vertical stroke. Zero on the logarithmic frequency scale corresponds to 100 Hz. Male speaker.

are superposed on the wave in straight succession, like pearls of varying length onto an undulating string. Thus, the rise-fall is more or less complete, according as the prosodic stress group is longer or shorter, and may be lacking altogether in monosyllabic stress groups. See further Thorsen 1984a, 1984b.

There is a further phenomenon to be noted in the delimitation of prosodic stress groups: Figure 3 depicts the course of F_0 in the underlined sequence of 'Dén øl ér lúnken' (That beer is tepid), i.e. [ˈøl ʔˈæʌ ˈlɔ]. The initial [l] in 'lúnken' behaves very much as if it were part of the preceding prosodic stress group: together with the preceding stressed diphthong it performs the characteristic low + high-falling pattern.

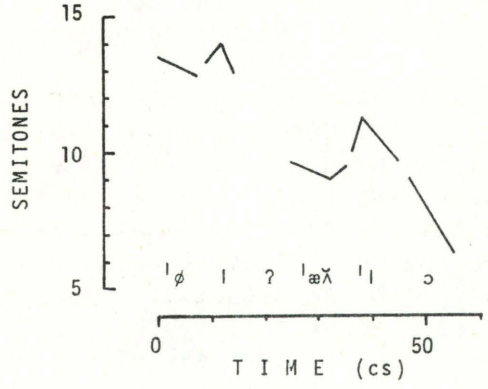


Figure 3

Fundamental frequency tracing of the underlined sequence in the utterance Dén øl ér lúnken. Zero on the logarithmic frequency scale corresponds to 100 Hz. Female speaker.

(The high consonant is not due to intrinsic F_0 level differences between the [l] and the vowels, because, if anything, the consonant has an intrinsically lower F_0.) In fact, the initial [l] in 'lűnken' behaves qualitatively exactly as the final [l] in 'øl'. Its more ample rising movement is due to the longer total duration of the sequence [æ͡ɅɅl] versus [øl], which allows for a more complete gesture before the downward course towards the next stressed vowel. In other words, the tonal syllabification seems to be V́C-V̄ rather than V̄-CV́, irrespective of phonological and morphological/syntactic boundaries. To summarize: an initial voiced consonant in a stressed syllable will be dissociated tonally from the stressed vowel and continue the F_0 pattern of the preceding context, if any. The perceptual relevance of the tonal association of an intervocalic consonant with the preceding or succeeding vowel has been tested, and it turned out that when vowel duration cues are ambiguous, the frequency location of the [l] alone can shift listeners' identification of synthetic stimuli between /'bilisd/ and /bi'lisd/. See further Thorsen 1984c. It seems, thus, that as far as its tonal manifestation goes, stress begins with the vowel. This matches observations from some tone languages that postvocalic consonants may carry the final part of the distinctive tonal course, but prevocalic consonants do not seem to be included, cf. Pike 1948, pp. 10, 30; Selmer 1928.

Prosodic segregation of initial consonants may not be a purely tonal phenomenon. Fischer-Jørgensen 1982, p. 159, presents evidence that under certain circumstances the pattern of segmental duration indicates a boundary between a prevocalic consonant and a stressed vowel. Recent experiments on Swedish indicate that the most reasonable account of rhythmic phenomena is achieved if the onset of the rhythmical unit is taken to be the onset of the stressed vowel rather than, say, the onset of the first prevocalic consonant. This was one of the conclusions drawn by Lubker et al. 1983 from data on articulatory compensation in bite-block experiments, and Strangert 1983 likewise found that the most appropriate segmentation for an account of inter-stress intervals is the onset of the stressed vowel.

DIALECTAL VARIATION IN STRESS GROUP PATTERNING

There is a great deal of variation across different Danish dialects, both in the shape of the F_0 pattern associated with prosodic stress groups and in the alignment of segments and syllables with the tonal pattern. Work that I am presently doing on the regional languages of Bornholm and in South Zealand demonstrates rather radical differences from Standard Danish. However, this presentation will burst at its seams if it is not restricted to Standard Danish.

SENTENCE INTONATION CONTOURS

Although sentence accent and emphasis for contrast are phenomena at the level of the stress group, and thus below the sentence or utterance in the hierarchy, I shall deviate from the natural order because these phenomena are more reasonably presented in the context of the sentence or utterance.

When the stress group pattern is a recurrent, predictable, qualitatively constant unit, the intonation contour can be defined in terms of the stressed syllables alone (which is entirely in line with the theory of Standard Danish intonation where global tendencies carry more local modifications). That is not to say that the course of the unstressed syllables is irrelevant for listeners' identification of intonation contours, only that they are redundant in the strict sense of the word. See further Thorsen 1980b. In short utterances, the intonation contours approach straight lines whose slopes vary in close correlation with the type and function of the utterance, as shown in figure 1: terminal declarative utterances have the steepest slopes, syntactically and lexically unmarked questions have horizontal contours. In between we find other types of questions as well as non-terminal sentences, with a tendency towards a trade-off between syntax/lexicon and intonation: the more syntactic or lexical information about the interrogative or non-terminal function of the sentence, the more falling, i.e. the more terminal declarative-like, is the intonation contour, and vice versa (a tendency also noted by Bo 1933, pp. 82-83, and Jespersen 1897-99, p. 592). A similar trade-off has been observed for other languages too, see e.g. Bolinger 1962, Cohen and 't Hart 1967, Daneš 1960, von Essen 1956, Hadding-Koch 1961, and Mikoš 1976. Furthermore, it appears that the tonal course is the same in utterances with identical prosodic structure, independently of syntactic constituents. See also above under the prosodic stress group.

LONGER UTTERANCES - PROSODIC PHRASING

If a declarative utterance contains more than three or four stress groups, most speakers will decompose the contour into several, shorter phrase contours, each with its own declination - which together describe an overall falling slope, cf. figure 4. The discussion of the results which underlie figure 4 was a very involved one, cf. Thorsen 1983a, especially as far as the interplay between prosodic structure, syntactic structure and semantics was concerned. Suffice it here to summarize that there are fairly strong grounds for claiming that some prosodic categories (in casu: prosodic stress groups and prosodic phrases) are distinct entities in the phonology that do not have an isomorphous relation to syntactic structure. That is, prosodic boundaries will be affiliated (but not coterminous) with syntactic ones (prosodic boundary location is a combined result of balancing

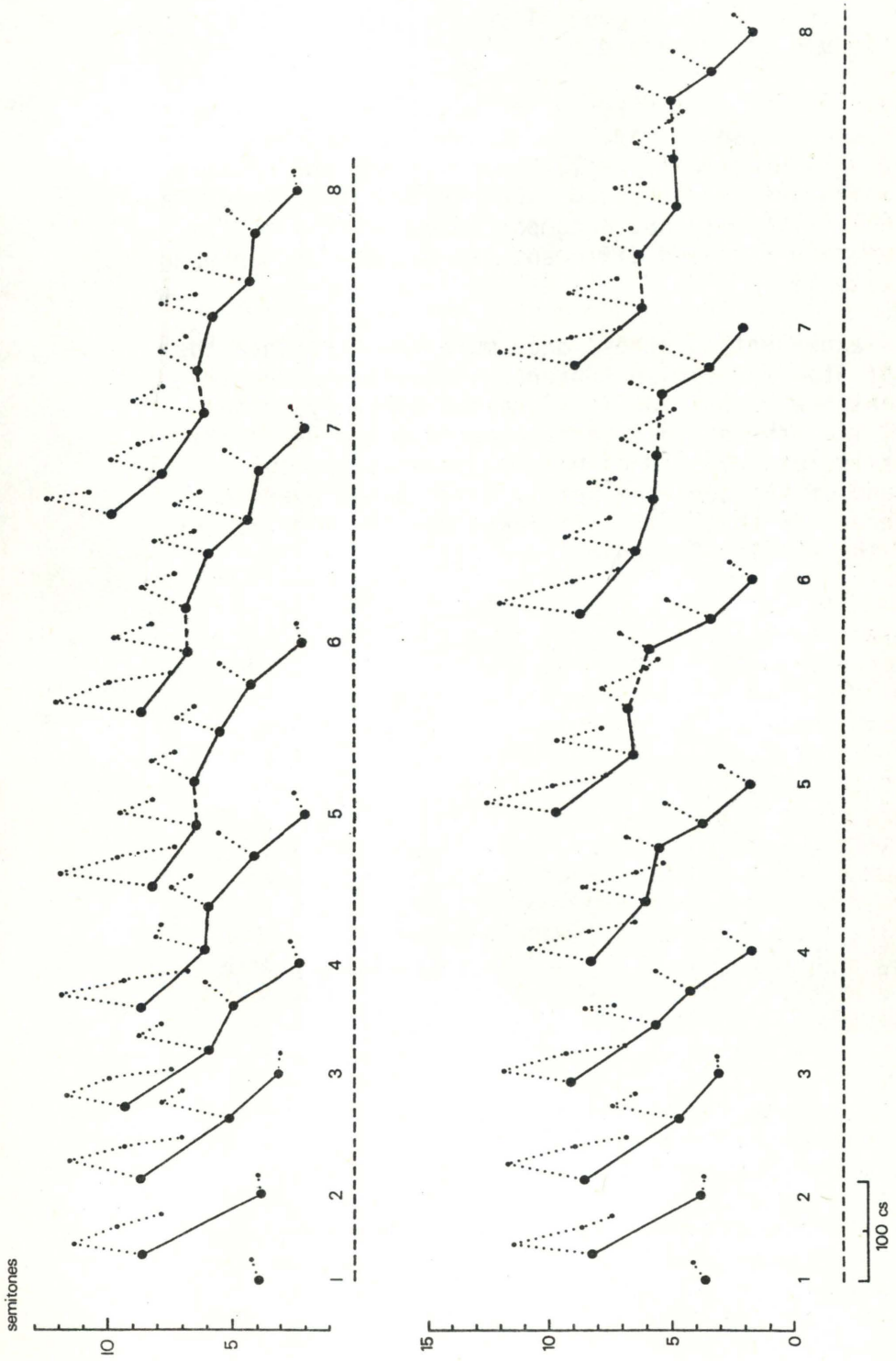


Figure 4

Intonation contours (full/broken lines) and stress group patterns (dotted lines) in two groups of terminal declarative utterances, consisting of one to eight prosodic stress groups. Average over four speakers. Large points denote stressed syllables, small points unstressed syllables. Broken lines denote the boundaries between prosodic phrases.

the length of the syntactic constituents in the utterance while taking into account their semantic content), but syntactic boundaries, inversely, need not leave any trace in the intonational structure of syntactically unambiguous, non-compound sentences. Whether syntactic boundaries can be traced in the time structure or in segmental cues is another question, and one that should be addressed.

How and to what extent this description would be applicable to spontaneous speech I cannot say. Spontaneous speech is rarely so fluent and so syntactically well structured as the edited, read speech which was investigated, and prosodic boundaries may be more evident (also when not accompanied by pauses) in free speech and may take more and different shapes than encountered in my 1983a material.

It is perhaps expedient to stress once more the fact that the description of Standard Danish sentence intonation above implies that sentence intonation is signalled globally rather than locally, i.e. the difference between, e.g., a declarative and interrogative utterance does not reside in a special movement at the end of the sentence but is distributed over the whole utterance. In this matter Standard Danish is different from most of the related Germanic languages.

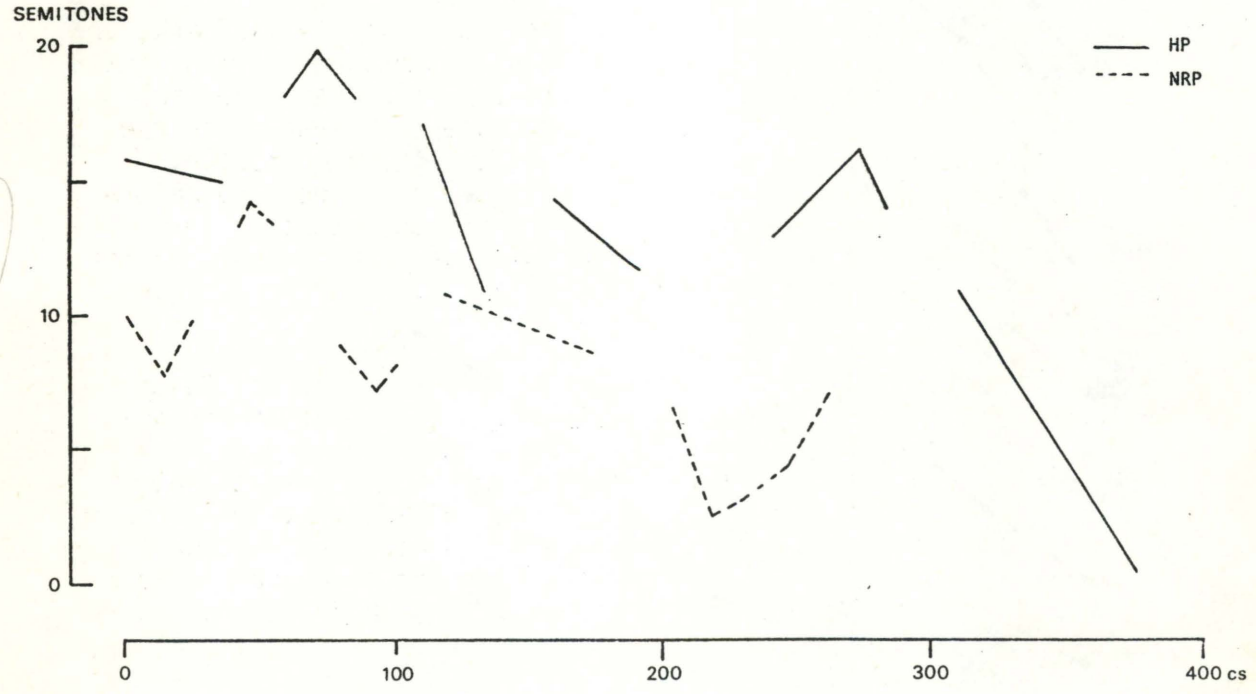


Figure 5

Fundamental frequency tracings (average over 6 recordings) of the utterance 'Torbens søster hedder Kamma' (Torben's sister's name is Kamma) by a male speaker from Bornholm (HP) and a male speaker from Copenhagen (NRP). Zero semitones corresponds to 60 Hz with NRP and 70 Hz with HP. (Note that NRP produced '-ter hedder' with continuous voicing, whereas HP paused very briefly before 'hedder'.)

It is also interesting to note that this feature is not shared by all Danish dialects. My studies on Bornholm (a Danish island off the coast of the southern part of Sweden) indicate that sentence intonation function is a matter more of a local, final movement than of differences in what precedes. Figure 5 is an example of average F_0 tracings of the same utterance, by a male speaker from Neksø on Bornholm, and a male speaker from Copenhagen. By far the most extensive F_0 movement is located within the last stress group ('Kamma') with HP, whereas the preceding F_0 variations are superposed on an only very moderately declining global trend. With NRP, on the contrary, local F_0 deflections, associated with the prosodic stress groups, are of approximately equal magnitude, but they ride on a slant whose slope is evenly distributed over the utterance. (You will also see that HP employs a far greater range than does NRP, which is another characteristic difference between the Bornholm region and Standard Danish. The considerable difference in utterance duration, however, is an individual feature.)

To what extent other Danish dialects will turn up with local sentence intonation function signalling, I cannot say. Possibly Southern Jutlandic, with its proximity to Germany, will deviate in the same manner that Bornholm does.

SENTENCE ACCENT

Standard Danish displays yet another peculiarity: it lacks an obligatory sentence accent, or focus, or nucleus. In pragmatically neutral speech all stressed syllables have the same weight or prominence. An extra prominence somewhere in the utterance is not present acoustically, nor perceptually. Pragmatically and prosodically neutral utterances are neither incomplete nor unnatural. Even if they do not occur very often in spontaneous speech, they are in no way conspicuous and they are very easy to elicit in recordings. See further Thorsen 1983b.

Again, Bornholm (and possibly other Danish dialects) is more in line with our nearest neighbours. It seems that Bornholm does have a sentence accent, though it is probably not obligatory. (There is a good deal of work to be done yet on the prosodic system of this island.)[1] Thereby it would resemble Skanian, i.e. the dialect of Southern Sweden (Gösta Bruce, Paul Touati personal communications). Figure 6 depicts averaged F_0 tracings of the same utterance as in figure 5, uttered under three different conditions: without a semantic context, and in answer to two questions which invite focus on the last and first items, respectively. (When these utterances are replayed without their context, they are easily identified, i.e. it is very easy to determine what their original context was, if any. - With the two Standard Danish speakers who recorded the same material as the seven Bornholm speakers, it is not possible to see any consistent differences between these conditions in the acoustic registrations, nor to auditorily

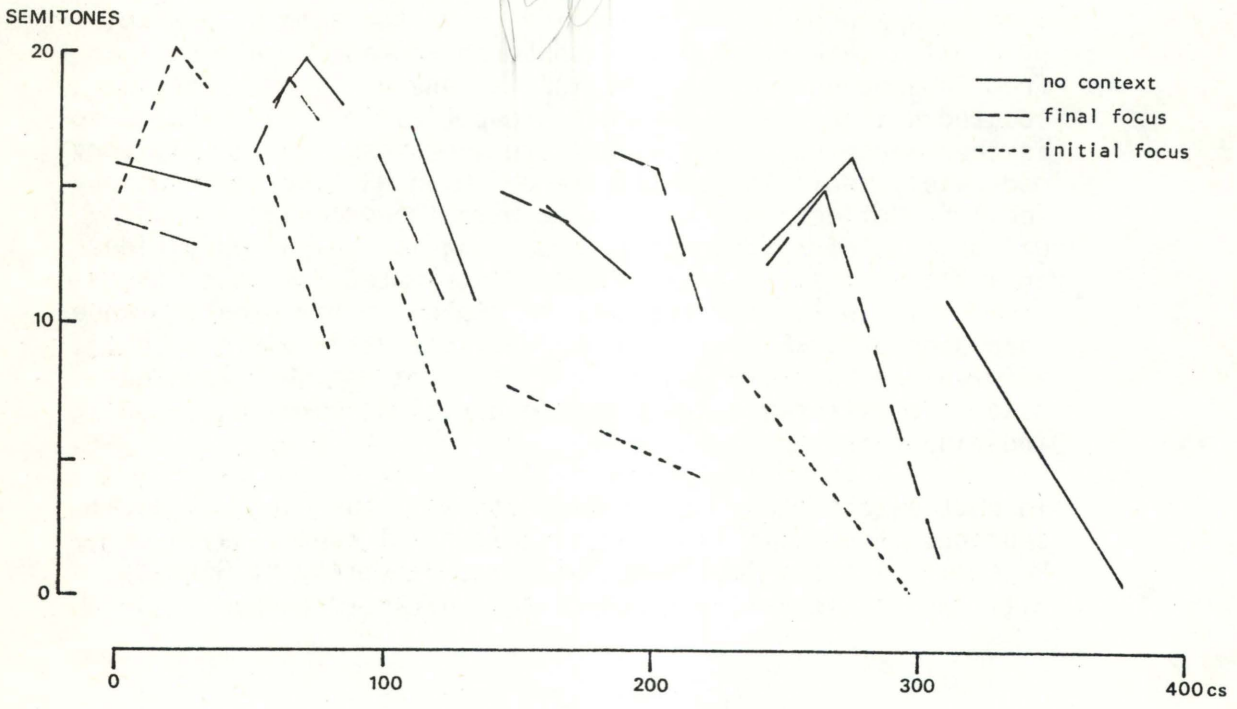


Figure 6

Fundamental frequency tracings (averages over 6 recordings) of the utterance 'Torbens søster hedder Kamma', uttered without a semantic context (full line); in answer to the question 'Hvad hedder Torbens søster?' (What's the name of Torben's sister?), i.e. with focus on the last item (wide broken line); and in answer to the question 'Hvem har en søster der hedder Kamma?' (Who has a sister named Kamma?), i.e. with focus on the first item (narrow broken line). Male speaker from Bornholm. Zero semitones corresponds to 70 Hz.

determine the context from which the (different) statements were taken, when replayed in isolation.) - Note that the principal difference between the neutral and final focus edition lies in the relation between the preceding unstressed syllables ('-ter hedder') and the onset of 'Kamma': the preceding F_0 pattern terminates higher than 'Kamma' in the neutral utterance, lower in the edition with focus on 'Kamma', besides a difference in the extent and complexity of movement within the final stress group, which is plainly falling in the neutral but rising-falling in the final focus edition.

With initial focus, the changes brought about, compared with the neutral utterance, are more radical: F_0 deflections after the focalized item are more or less deleted, and the whole tail of sy lables after 'Tor-' runs smoothly from the high onset to the bottom of the speaker's range. - This is entirely

in line with descriptions of the tonal manifestation of focalization in other languages, e.g. German (Bannert 1985) and Swedish (Bruce 1977). Note the considerable shortening involved when the utterance contains a sentence accent. This is a general feature of all seven Bornholm speakers. It is interesting because of the light it throws on the discussion about the reason for 'final lengthening'. Several languages, among them Swedish, are reported to have longer syllables preceding an utterance boundary, ceteris paribus. This lengthening has been taken by some (e.g. Lyberg 1979) to be a consequence of the more elaborate F_0 movements finally in the utterance, where the sentence accent is located if nothing else is specified by the context. The explanation has been refuted by Bannert 1982, and certainly its universal validity is flatly denied by my data from Bornholm: 'Kamma' has a more elaborate and more extensive F_0 movement when focalized but it is shorter than the non-focalized word in final position. (The difference is often, but not invariably - with all utterances, or all speakers - statistically significant.) Furthermore, when a given item is compared over initial versus final positions in the non-focalized editions, where the final movement - due to the local signalling of sentence intonation - is far more elaborate than the initial one (cf. figure 5), the item's duration is generally significantly shorter in final position.

CONTRAST AND EMPHASIS

The semantic borderline between emphasis for contrast (whether implicit in the context or explicitly stated) and other types of emphasis cannot always be clear-cut. Likewise, there is probably a grey zone between contrast emphasis and sentence accent, in languages or dialects where this is a meaningful concept. - It is outside the scope of this chapter to attempt to weed out the muddiness in the classification of various types of emphasis. The results presented summarily here are derived from utterances where the contrasted item is explicitly stated (e.g.: 'Sorry, what did you say? - Do the buses leave from Tiflis or from Grosny?' -- 'There are many buses out of Tiflis. - As far as I can see there is no connection from Grosny at all.' or: 'Does pipípi have shorter syllables or just shorter vowels?' -- 'pipípi has shorter syllables.') You will see from the stylized tracings in figure 7 that emphasis for contrast in Standard Danish is achieved tonally by making the stressed syllable of the emphasised word stand out clearly from the surroundings, which is brought about by raising it (except in initial position) and by lowering and shrinking the F_0 deflections in the surrounding stress groups, in a manner so that the immediate surroundings - except the first post-tonic syllable - fall away sharply from the emphasized syllable. (There are hints in my data that stress groups further removed from the contrasted element do not suffer a similar shrinking, which is what motivates the restriction of the following generalization to short utterances.)

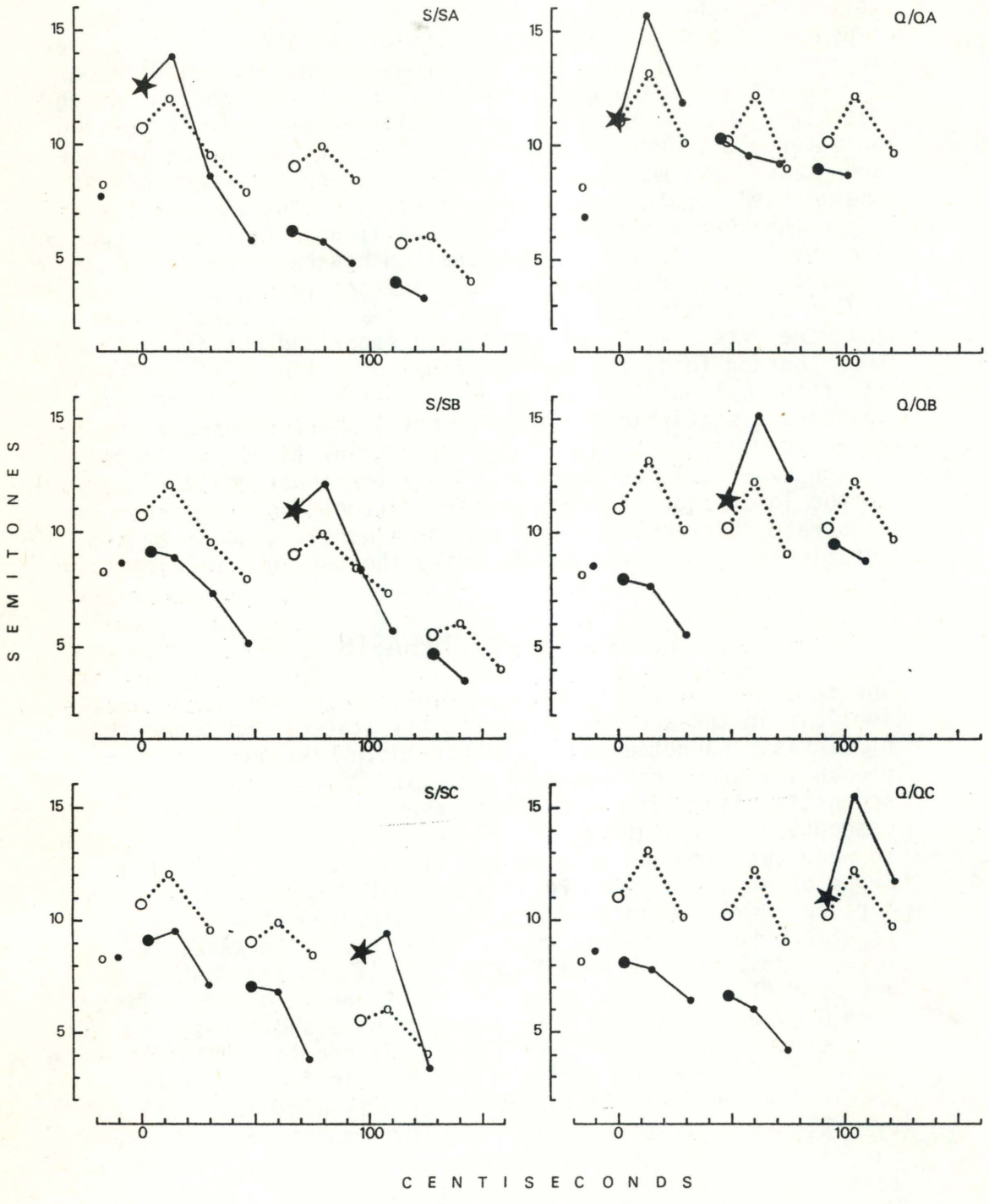


Figure 7

Stylized tracings of the course of F_0 in statements (S - left) and questions (Q - right), which are prosodically neutral (open circles and dotted lines) or have emphasis for contrast (stars, points and full lines) in initial position (top), medial position (mid) and final position (bottom). Stars denote the emphatically stressed syllables, large points denote other stressed syllables, and small points depict unstressed syllables.

The changes induced by contrast, when compared with the prosodically neutral editions can be formulated thus: In short utterances with emphasis for contrast, the utterance reduces tonally to one prosodic stress group. That is, only one low + high-falling F_0 pattern occurs in them. An informal experiment with LPC-analysis and re-synthesis which I had occasion to perform at the University of Uppsala showed that the perceptually salient feature of contrast emphasis resides in the shrinking of the surroundings, rather than in the upwards change of the emphasized syllable itself. Thus, in an utterance like 'Det er sidste bus til Tiflis.' (It is the last bus for Tiflis.) it is the shrinking of the F_0 movements associated with 'sidste' and 'Tiflis', rather than a higher F_0 location of 'bus', that will make 'bus' appear as the contrasted element.

TEXTUAL INTONATION

There are data from several languages that prove paragraphs or texts to have an overall intonational structure to which the constituent sentences are subordinated, cf. Bruce 1982 (Swedish), Lehiste 1975; Cooper and Sorensen 1981 (American English), Uyeno et al. 1980 (Japanese). So is also the case in Danish. (A 'text' here is a sequence of semantically but not necessarily syntactically coordinated sentences.) Figure 8 summarizes the analysis of texts consisting of one, two, or three sentences. These sentences were semantically coherent (they described what various members of a family were doing during their summer holidays). In one set of texts they were syntactically

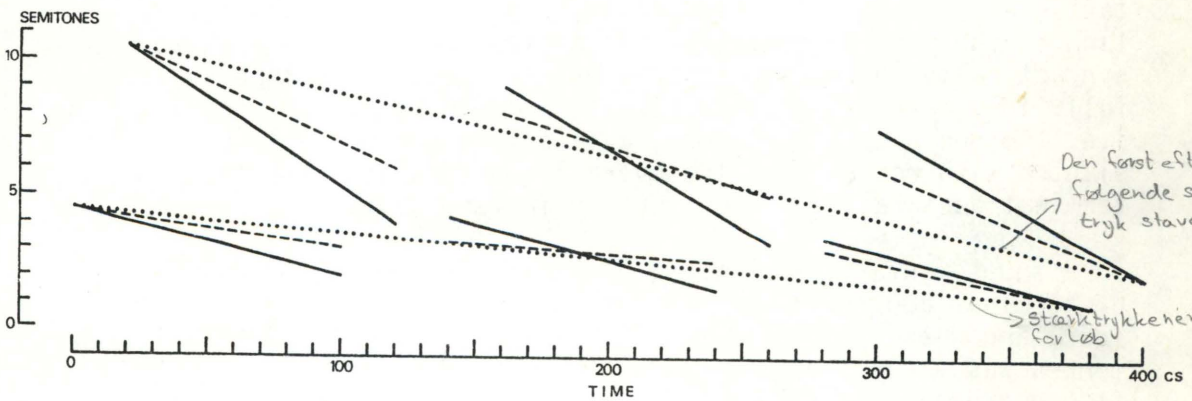


Figure 8

Stylized model of the course of Fo in texts with three terminal declarative sentences (full lines) and three coordinate main clauses (broken lines). The lower lines connect the stressed syllables, i.e. they represent the intonation contours (cf. figure 1), the upper lines connect the first unstressed syllable in each stress group. The dotted lines represent the overall slope through the text. A text with two components is arrived at by leaving out the middle component. An isolated sentence arises when the dotted lines are suitably compressed in time.

uncoordinated, i.e. each sentence was a terminal declarative, separated orthographically from its neighbours by periods. In another set the same sentences occurred as coordinate main clauses, separated by commas and 'og' (and). For instance: 'Amanda skal afsted på camping. Hendes mor skal på kursus i Tyskland.' And: 'Hendes far skal vandre i Lapland, og Amanda skal afsted på camping, og hendes mor skal på kursus i Tyskland.' (Amanda is going away camping. Her mother is taking a course in Germany. -- Her father is going hiking in Lapland, and Amanda is going away camping, and her mother is taking a course in Germany.) Figure 8 should be read as follows. See e.g. the full lines. The lower line in each of the three pairs of lines corresponds to the broken lines in figure 1, that is it is the line which supports the stressed syllables of the sentence. The upper line, similarly, is the one which would carry the first post-tonic syllable in each stress group, i.e. the local 'highs' in the course of F_0. In other words, upper and lower lines delimit the space within which F_0 performs its undulating course through each sentence (disregarding the fact that with a sufficiently large number of post-tonic syllables, they may transgress the line connecting the stressed syllables). The full lines pertain to sequences of terminal declaratives, the broken lines depict syntactically coordinate main clauses. The dotted upper and lower lines describe the overall textual contour.

Clearly, each sentence is associated with its own declining sentence intonation contour, but together two or three such contours describe an overall downward trend, i.e. the onset and offset of upper and lower lines, respectively, decrease gradually through the text. Furthermore, the different syntactic arrangement is reflected in a difference of subordination to the overall contour: the broken lines, pertaining to syntactically coordinate structures, are less steep than the full lines describing syntactically uncoordinated sentences, i.e. the coordinate sentences deviate less from, are less slanted with respect to, the overall contour, than are the terminal declaratives. See further Thorsen 1985.

In a supplementary experiment, Thorsen 1986, where the number of terminal declaratives in a text was varied (between one and four) and where, furthermore, the length of individual sentences was varied (between two and four prosodic stress groups), it was proved that the overall trend described in figure 8 is not the result of a special 'initial high' and 'final low' effect: A sequence of four declarative sentences also shows a gradual decline. However, it appeared that the textual contour is sensitive, not only to the number of sentences that make up the text, but also to the length of individual sentences. This is due to the fact that, apparently, a declarative sentence must have a certain negative slope associated with it in order to serve appropriately as a declarative. This demand may conflict with a lowering of sentence onsets through the text: the longer the sentence, the higher its onset must be in order to preserve a suitable slope and simultaneously prevent the speaker from falling through the floor of his F_0 range.

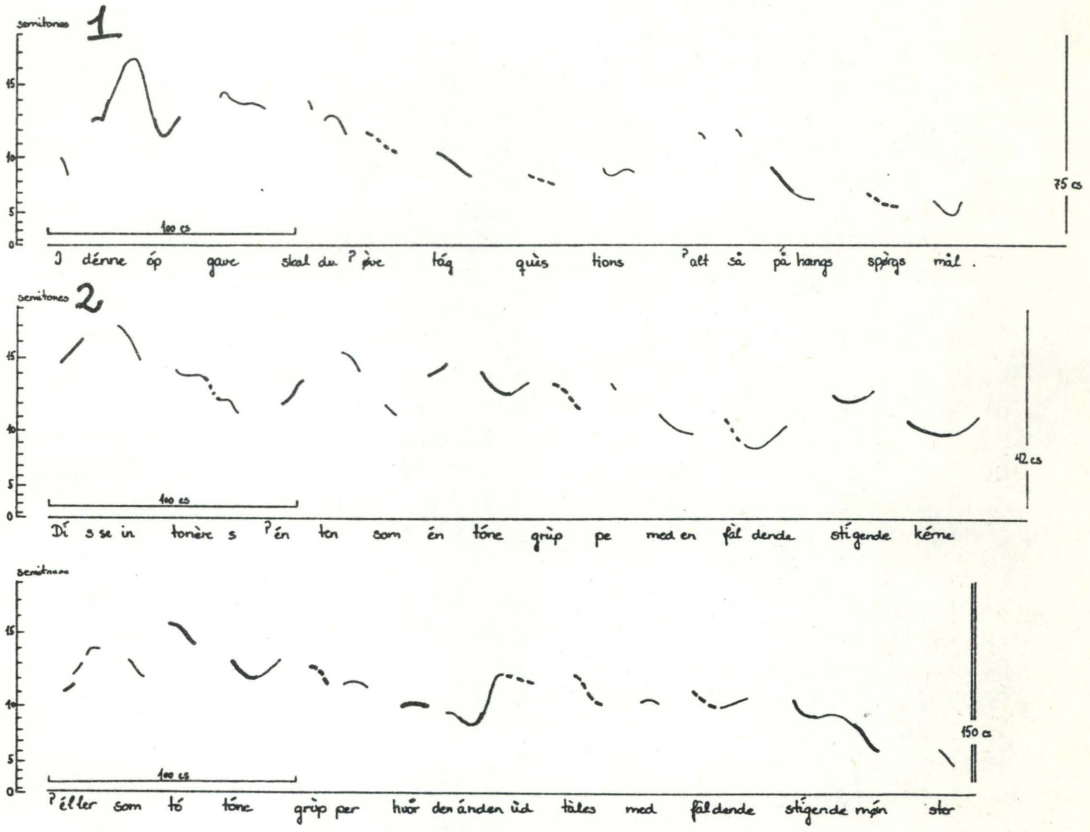


Figure 9

Fo tracings of the first two sentences in a long text. The stressed vowels have been touched up with thicker lines. Syllables with secondary stress are indicated with broken lines. Vertical bars indicate pauses, with pause duration in centiseconds added. Zero on the logarithmic frequency scale corresponds to 100 Hz. Female speaker.

INTONATION IN A NON-EDITED TEXT

It is worth pointing out, once more, that everything that has been said above is based on analyses of highly edited, read speech. The preliminary results (Thorsen 1987a) to be summarized in the following are based on a text which was read, but which was not edited for intonation analysis purposes. The investigation represents a first, cautious step on the road to analyse free, spontaneous speech. The text is the tape-recorded instruction to a language laboratory exercise, amounting to a total of five type-written pages. It was recorded once, by one speaker, the author of the programme.

Figure 9 shows F_0 tracings of the first two sentences in the text. I have been particularly interested in the tonal pattern associated with prosodic stress groups: whether they would

appear in the same regular and predictable shape as in the pragmatically much more restrained texts analysed previously. The answer is both yes and no. The text contained 341 polysyllabic prosodic stress groups. Only 32 of those, or 9%, do not have an associated F_0 rise. So it appears justified to conclude that a sequence of stressed plus unstressed syllable(s) is normally accompanied by a rise in F_0. The magnitude of the rise, however, varies a good deal, and I cannot assert that it decreases in a monotonous and simple fashion through the phrase or utterance, as it does in short, pragmatically restricted sentences. Nor have I been able to disclose any other systematic trend in the vacillation of the low-to-high interval. I venture to propose that varying the magnitude of the pitch rise from the stressed syllable - as this speaker does - serves pragmatic purposes in that it lends slightly varying degrees of prominence to the stressed syllables, without their falling out of the range of what may be termed neutral, non-emphatic, main stress. Thus, greater prominence would be associated with a higher rise after the stressed syllable.

It is important to note that rise in pitch from a stressed syllable to the post-tonic is not the only cue to its stressedness. (This is evident in the case of monosyllabic stress groups, where there are no post-tonics to carry such a rise.) Instead, I propose, the relation to surrounding stressed syllables may determine a syllable as stressed. That is, if a syllable falls into place in a rhythmic pattern and an intonational contour, established by preceding and/or succeeding stressed syllables, and if its duration, its vowel quality, and its lack of stød do not contradict it, such a syllable will be perceived as stressed. It may further warrant a characterization as ACCENTED if it is succeeded by one or more post-tonics and has an associated pitch rise; if there is no such pitch rise to post-tonics the stressed syllable is NON-ACCENTED. The distinction between accented and non-accented stressed syllables does not apply to monosyllabic stress groups.

The distinction, if it is tenable, between stress and accent, as outlined above, would bring Standard Danish on a par with German, as described by Bannert 1985, with British English, as described by O'Connor and Arnold 1961, and with Dutch, as described by 't Hart and Collier 1979, where a similar distinction can be made between stressed syllables which are tonally prominent (accented) and stressed syllables which are not (non-accented).

It appears then that in read speech in Danish, at least the speech I have analysed so far, stressed syllables are <u>normally</u> also accented. In the materials I had looked at before this one, this has been true without exception, which is why I have not thought to introduce a distinction between stress and accent before. In retrospect, the behaviour of stressed syllables surrounding an emphasis for contrast could have provoked a discussion of accented versus non-accented: stressed syllables which are neighbours to an emphasis for contrast suffer a reduction or deletion of their F_0 pattern, cf. figure 7.

However, I am not sure whether this reduction is not also a de-stressing (that is how it has been treated previously). This is clearly a point where empirical research is called for, both in terms of acoustic and perceptual studies.

There is one snag about the dichotomy accented/non-accented, if it is to apply to stressed syllables only. There are 104 syllables with secondary stress in the text. 95 of those are succeeded by unstressed syllables. 21 of those 95, i.e. 22%, are associated with a rise in F_0! Does this mean that secondary stresses may also be accented? Or does it mean that the stress reduction is only partial? Previously, secondary stresses have been characterized prosodically as lacking the pitch rise typical of main stress, but retaining all other stress cues (duration, quality, stød). - If accented/non-accented is a relevant distinction in stressed syllables, then lack of pitch rise is not a feature confined to secondary stresses. Conversely, if there are secondary stresses with associated pitch rises, then accentuation is not confined to stressed syllables.

There is a vast amount of research to be done on stress and its (tonal) manifestation in Danish, not least perceptual experiments, before the descriptive categories can be definitively established.

DANISH INTONATION IN INTERNATIONAL PERSPECTIVE

It will be apparent from the preceding sections that Danish shares some features with its nearest Germanic neighbours, but differs from them in some important respects: The basic units of description are the same, or can be made to be identical across Danish, Swedish, German and English, namely text, utterance (sentence), phrase, foot or stress group, and syllable. (The data available on Norwegian at levels above the word are too scarce to allow a cross-language comparison.) It is also a common feature that prominence (stress or accent) is signalled with a tonal change associated with the stressed or accented syllable. (It is still an open question whether a distinction between stressed syllables and accented syllables, as it applies to German and English, should be postulated for Danish.) The acoustic manifestation of contrast is apparently alike in the four languages: increased tonal range associated with the stressed syllable of the emphasized item and a simultaneous tonal reduction in the neighbouring feet. Danish differs from the above languages in not having an obligatory sentence accent, or nucleus, and by not having any strong final lengthening. - Furthermore, sentence intonation function in Standard Danish is signalled by the global trend exhibited by the undulating F_0 deflections through an utterance, as opposed to the more local, final F_0 movement in Swedish, German, and English.

NOTE

This manuscript was completed in December 1986. As you will see from my paper on Bornholm intonation in this volume, I have also had occasion to hypothesize a distinction between syntactically and/or prosodically conditioned sentence accents or *default sentence accents* versus the pragmatically conditioned *focal sentence accents*.

REFERENCES

Andersen, P. 1954: Dansk fonetik. Chapter XV of *Nordisk Lærebog for Talepædagoger*, Rosenkilde & Bagger, Copenhagen, p. 308-354.

Bannert, R. 1982: An Fo-dependent model for segment duration? *Reports from the Institute of Linguistics, Uppsala University 8*, p. 59-80.

Bannert, R. 1985: Fokus, Kontrast, und Phrasenintonation im Deutschen. *Zeitschrift für Dialektologie und Linguistik 52*, p. 289-305.

Basbøll, H. 1877: *Dansk Fonetik og Fonologi - Skitse til en Systematisk Indføring*. Nordisk Institut, Odense Universitet.

Basbøll, H. 1985: Stød in modern Danish. *Folia Linguistica XIX*, p. 1-50.

Bo, A. 1933: Tonegangen i Dansk Rigsmål, *Studier fra Sprog- og Oldtidsforskning, 164*. Branner, Copenhagen.

Bolinger, D.L. 1962: Intonation as a universal. *Proceedings of the IXth International Congress of Linguists*, p. 833-848.

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

Bruce, G. 1977: Swedish word accents in sentence perspective. *Travaux de l'Institut de Linguistique de Lund 12*, p. 1-155.

Bruce, G. 1982: Textual aspects of prosody in Swedish. *Phonetica 39*, p. 274-287.

Cohen, A. and 't Hart, J. 1967: On the anatomy of intonation. *Lingua 19*, p. 177-192.

Cooper, W.E. and Sorensen, J.M. 1981: *Fundamental Frequency in Sentence Production*. Springer-Verlag, Berlin.

Daneš, F. 1960: Sentence intonation from a functional point of view. *Word 16*, p. 34-54.

von Essen, O. 1956: Hochdeutsche Satzmelodie. *Zeitschrift für Phonetik, Kommunikation und Sprachwissenschaft 9*, p. 75-85.

Fischer-Jørgensen, E. 1982: Segment duration in Danish words and its dependency on higher level phonological units. *Annual Report of the Institute of Phonetics, University of Copenhagen 16*, p. 137-189.

Fischer-Jørgensen, E. 1987: The phonetic manifestation of the 'stød' in Standard Danish. *Annual Report of the Institute of Phonetics, University of Copenhagen 21*, p. 55-282.

Gårding, E. 1977: The Scandinavian word accents. *Travaux de l'Institut de Linguistique de Lund 11*, p. 1-116.

Hadding-Koch, K. 1961: Acoustico-phonetic studies in the intonation of southern Swedish. *Travaux de l'Institut de Linguistique de Lund 3*, p. 1-211.

't Hart, J. and Collier, R. 1979: On the interaction of accentuation and intonation in Dutch. *Proceedings of the 9th International Congress of Phonetic Sciences, vol. II*, p. 395-402.

Jespersen, O. 1897-99: *Fonetik*. Det Schubotheske Forlag, Copenhagen.

Ladd, D.R. 1983a: Peak features and overall slope. in: A. Cutler and D.R. Ladd (eds.): *Prosody - Models and Measurements*. Springer-Verlag, Berlin, p. 39-52.

Ladd, D.R. 1983b: Phonological features of intonational peaks. *Language 59*, p. 721-759.

Lehiste, I. 1975: The phonetic structure of paragraphs. in: A. Cohen and S. Nooteboom (eds.): *Structure and Process in Speech Perception*, Springer-Verlag, Berlin, p. 195-206.

Liberman, M.Y. and Pierrehumbert, J. 1984: Intonational invariance under changes in pitch range and length. in: M. Aronoff and R.T. Oehrle (eds.): *Language Sound Structure*, M.I.T. Press, p. 157-233.

Lubker, J., Lindblom, B., Gay, T., Lyberg, B., Branderud, P. and Holmgren, K. 1983: Prosody and compensatory motor behaviour. Abstract of a paper read at a symposium on *Prosody - Normal and Abnormal*, Zürich, April 6-8.

Lyberg, B. 1979: Final lengthening - partly a consequence of restrictions on the speed of fundamental frequency change? *Journal of Phonetics 7*, p. 187-196.

Mikoš, M.J. 1976: Intonation of questions in Polish. *Journal of Phonetics 4*, p. 247-253.

O'Connor, J.D. and Arnold, G.F. 1961: *Intonation of colloquial English*. Longmans, London.

Pierrehumbert, J. 1980: *The Phonology and Phonetics of English Intonation*. M.I.T., Doctoral dissertation.

Pike, K.L. 1948: *Tone Languages*. University of Michigan Press, Ann Arbor.

Rischel, J. 1969: Morpheme stress in Danish. *Annual Report of the Institute of Phonetics, University of Copenhagen 4*, p. 111-144.

Selmer, E.W. 1928: Noen bemerkninger om den musikalske aksent i dens forhold til den sterkt og svakt skårne aksent. *Festskrift til Rektor J. Qvigstad, Tromsø Museums Skrifter 2*, p. 250-262.

Strangert, E. 1983: Temporal characteristics of rhythmic units in Swedish. in: C.-C. Elert, I. Johansson and E. Strangert (eds.): *Nordic Prosody III*, Almqvist & Wiksell, Stockholm, p. 201-213.

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

Thorsen, N. 1980a: Word boundaries and Fo patterns in Advanced Standard Copenhagen Danish. *Phonetica 37*, p. 121-133.

Thorsen, N. 1980b: A study of the perception of sentence intonation - Evidence from Danish. *Journal of the Acoustic Society of America 67*, p. 1014-1030.

Thorsen, N. 1980c: Neutral stress, emphatic stress, and sentence intonation in Advanced Standard Copenhagen Danish. *Annual Report of the Institute of Phonetics, University of Copenhagen 14*, p. 121-205.

Thorsen, N. 1983a: Standard Danish sentence intonation - Phonetic data and their representation. *Folia Linguistica 17*, p. 187-220.

Thorsen, N. 1983b: Two issues in the prosody of Standard Danish. in: A. Cutler and D.R. Ladd (eds.): *Prosody: Models and Measurements*. Springer-Verlag, Berlin, p. 27-38.

Thorsen, N. 1984a: The tonal manifestation of Danish words containing assimilated or elided schwa. in: C.-C. Elert, I. Johansson and E. Strangert (eds.): *Nordic Prosody III*, Almquist & Wiksell, Stockholm, p. 215-230.

Thorsen, N. 1984b: Variability and invariance in Danish stress group patterns. *Phonetica 41*, p. 88-102.

Thorsen, N. 1984c: F_0 timing in Danish word perception. *Phonetica 41*, p. 17-30.

Thorsen, N. 1985: Intonation and text in Standard Danish. *Journal of the Acoustic Society of America 77*, p. 1205-1216.

Thorsen, N. 1986: Sentence intonation in textual context - supplementary data. *Journal of the Acoustic Society of America 80*, p. 1041-1047.

Thorsen, N. 1987a: Text and intonation - a case study. in: K. Gregersen and H. Basbøll (eds.): *Nordic Prosody IV*, Papers from a symposium June 6-8, 1986, Odense University Press, p. 71-79.

Thorsen, N. 1987b: Intonation and text in Standard Danish - with special reference to the abstract representation of intonation. in: W.U. Dressler et al. (eds.): *Phonologica 1984*, Cambridge University Press, p. 301-309.

Uyeno, T., Hayashibe, H., Imai, K., Imagawa, H. and Kiritani, S. 1980: Comprehension of relative clause construction and pitch contours in Japanese. *Annual Bulletin of the Research Institute of Logopedics and Phoniatrics 14*, p. 225-236.

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INTONATION ON BORNHOLM - BETWEEN DANISH AND SWEDISH

NINA GRØNNUM THORSEN

Acoustic investigations of seven speakers on the island of Bornholm and two speakers from Copenhagen, Malmö and Stockholm, respectively, have proved Bornholm to be an interesting compound, prosodically, between Standard Danish and Swedish. A prosodic continuum can be established from Standard Danish, via Skania, over Bornholm, to Standard Swedish. The parameters investigated are (1) manifestation of sentence accent, (2) manifestation of sentence intonation, (3) alignment of fundamental frequency with syllables and segments at the level of the prosodic stress group, and (4) final lengthening. One particularly interesting implication of the results is the division, both according to their function and their form, of sentence accents into (1) prosodically or syntactically determined final default accents and (2) contextually or pragmatically determined focal accents. Default accents are non-existent in Standard Danish and Skanian, optional in Bornholm and obligatory in Stockholm. Focal accents are non-existent in Standard Danish, optional - but rather rare - in Skanian, optional - but rather frequent - in Bornholm and obligatory in Stockholm.

I. INTRODUCTION

The research presented here is part of a larger project which entails similar investigations in three other Danish areas (provincial towns), which in its turn is part of a five-year project, commenced in 1986, engaging numerous researchers, funded by the Research Council of the Humanities, called 'Spoken Danish in its varieties'.

The island of Bornholm is situated just off the Skanian south coast, closer, geographically, to Sweden than to Denmark. Also, the language spoken on the island forms a whole with the rest of the East Danish, or Skanian, dialects, cf. Areskoug (1957, 29-35). It is not unreasonable to expect that its prosody will reveal at least some features that are related to the prosodic systems of both Danish and Swedish.

A number of questions raise themselves from a background of what is known to-day about Standard Danish, Skanian, and Standard Swedish:[1],[2] (1) Does Bornholm have a sentence accent? (Danish does not, Swedish does, and in Skanian it is said to be optional). (2) Does sentence intonation get signalled globally throughout the utterance (as in Danish) or locally (finally - as in Swedish)? (3) How do tonal patterns behave under variations in duration? (In Danish, the fundamental frequency (Fo) patterns associated with the prosodic stress group is truncated when the stress group is shortened; in Swedish, at least under certain conditions, the tonal pattern is compressed in time, i.e. its movements are quicker and steeper.) (4) Does Bornholm have lengthening of syllables and segments before prosodic boundaries, e.g. sentence boundaries? (In Danish it is slight, in Swedish it is considerable.) Finally, Bornholm differs from Danish in not having stød[3] , but nor does it have tonal word accents like Swedish. Evidence for this fact should be apparent throughout the material presented here.

I should point out at the outset that I have not intended to investigate the dialects proper in any of the areas I have visited, but rather the present-day regional standard language of the respective provincial towns. This language may be characterized as Standard Danish on, e.g., a Bornholm substratum. Accordingly, the material has been presented to the speakers in standard orthography and it adheres to the morphology and syntax of the standard language. The only adjustments to the town in question have been semantic, in the names of cities to be travelled to, objects to be sold or bought, etc., so that the speakers might feel that they were talking about items familiar to them. The aspect of speech which presumably suffers least, however, from the transition from dialect to regional standard language is the prosody. And prosody is also the main reason why speakers from different parts of the country can be located geographically, even though they conform to the standard norm in all, or most, other respects.

Secondly, I am fully aware of the limitations imposed on an investigation which deals with highly monitored speech read into a microphone, in terms of loss of spontaneity and naturalness. However, the procedure can be defended on two grounds. One, it enables you to isolate certain aspects of speech, while keeping everything else constant, and thus be sure that the description of, say, the relation between stress and Fo is not fouled up by interference from, say, sentence accent or junctures. Two, you may reasonably expect that the intonational structures thus disclosed will also appear in spon-

taneous speech, that they are the neutral minimum upon which a speaker operates in less rigid semantic and pragmatic circumstances.

The investigation is meant to be only exploratory. Hopefully, the material recorded and analysed will enable me to point to those areas with which it will be most rewarding to carry on in the future.

II. PROCEDURES

A. THE BORNHOLM RECORDINGS

1. Material

(1) To look at the realization of sentence accent, if it is manifest at all, three sentences were made up, where the same word occurs as the first, middle and last stressed word, respectively (the stressed vowels are indicated with acute accents here and intended sentence accents with plus symbols):

Kámma stámmer fra Sváneke.	(Kamma comes from Svaneke.)
Ánders og Kámma skal til Sándvig.	(Anders and Kamma are going to Sandvig.)
Tórbens søster hedder Kámma.	(Torben's sister is called Kamma.)

These utterances are presented in isolation, i.e. without any context at all, as well as in two different contexts, designed to evoke a sentence accent on Kamma and on some other word in the utterance, respectively. These contexts took the form of questions to which the sentences above were the answer.

Ved du hvor Kamma er født? (Do you know where Kamma was born?)
Kámma stámmer fra Svåneke.

Hvem af dem er født i Svaneke? (Who among them was born in Svaneke?)
Kåmma stámmer fra Sváneke.

Hvor skal de unge holde ferie? (Where are the children going for holidays?)
Ánders og Kámma skal til Såndvig.

Hvem skal til Sandvig foruden Anders? (Who, besides Anders, is going to Sandvig?)
Ánders og Kåmma skal til Sándvig.

Hvad hedder Torbens søster? (What is Torben's sister's name?)
Tórbens søster hedder Kåmma.

Hvem har en søster der hedder Kamma? (Who has a sister called Kamma?)
Tårbens søster hedder Kámma.

The distinction between sentence accent and emphasis for contrast may not always be clear-cut semantically or pragmatically in spontaneous speech. There will be many instances where a prominence is open to both interpretations. But in a read material of this kind it ought to be possible to elicit either one or the other (or both, of course). Thus, the question 'Ved du hvor Kamma er født?' focalizes on Kamma's birthplace, but does not contrast it with other possible places of birth as, e.g., the question 'Er Kamma født i Sandvig eller i Svaneke?' would have done (Was Kamma born in Sandvig or in Svaneke?).

Sentence accent and emphasis for contrast may have different phonetic manifestations, as is evident in German data published by Bannert (1985): A sentence accent may be preceded by accented syllables (stressed syllables associated with an Fo excursion), but no such syllables may follow a sentence accent, so stressed syllables after a sentence accent steer a smooth, undeflected course to the end of the utterance. Bannert (1985) notes that in his material, emphasis for contrast is associated with a larger Fo movement on the stressed syllable of the contrasted item, and it appears from his figures that there is a further difference between sentence accent and contrast: the Fo movements preceding the contrasted syllable are also partially suppressed or completely deleted, so the only clear Fo excursion is the one associated with the contrast. This is also how emphasis for contrast is manifested in Standard Danish, cf. Thorsen (1980b). - It would have been very interesting to see whether a similar difference exists in Bornholm (to the extent that a sentence accent is manifested at all). However, I did not dare include the necessary dialogue material, for fear that speakers would - in the course of reading - get confused about the two types (sentence accent and contrast) and mix them up.

The nine sentences above will also allow me to look at the relation between stress and Fo as well as the realization of terminal declarative intonation.

(2) To further illustrate sentence intonation phenomena, a fairly long declarative utterance was made up:

Kőfoed og Thórsen skal med rũte-bilen fra Gũdhjem til Snógebæk klokken fíre på tírsdag.	(Kofoed and Thorsen are taking the bus from Gudhjem for Snogebæk at four o'clock on Tuesday.)

as well as a dialogue with a question word and a one-stress echo-question:

Hvor lángt ér der fra Sándvig til Svåneke? Til Svåneke? - Der er cirka 30 kilometer.	(How far is it from Sandvig to Svaneke? To Svaneke? - It is about 30 kilometres.)

(3) Two sentences occur which have (a) one stress group with a fairly large number of post-tonic syllables, and (b) a polysyllabic word with stress on its last syllable, respectively (this last to certify that word boundaries leave no trace in Fo - as it does not in Danish, Skanian or Swedish, cf. Thorsen 1980a, 1982, 1984, Bruce 1977 and Touati 1987):

De sídste síldefiskere må snárt lægge óp.	(The last of the herring fishermen will soon have to lay up their ships.
Turísterne købte keramík for tó millioner krõner.	The tourists bought two million crowns worth of ceramics.)

To look in more detail at the coordination of Fo and segments, five utterances were constructed which contain a stress group (underlined here) whose voiced part grows progressively shorter, from top to bottom:

De fik kánerne frém til nýtår.	(They got out the sleighs for New Year's.
Hun fik kánderne fýldt til kánten.	She had the jugs filled to the brim.
Hun fik kánden fýldt med mælk.	She had the jug filled with milk.
Kõldt vánd slúkker tørsten.	Cold water quenches your thirst.
En grå kát krádser.	A grey cat scratches.)

The last two utterances are ill-considered on my part. I neglected the fact that here the stress group under scrutiny is not the first one in the sentence. And to the extent that an initial juncture is manifest - which will make the first stress group differ from succeeding ones - the five underlined sequences are not immediately comparable.

(4) Turísterne forøger befólkningstallet om sõmmeren.	(The tourists increase the population during the summer.
Mánge bórnholmere léver af turísterne.	Many Bornholmians live off the tourists.)

These two utterances should disclose a final lengthening, granted that the second one did not receive a sentence accent on the last word, which could then be made responsible for triggering longer segments and syllables in '-rísterne.' I presumed that if a sentence accent occurred, it would hit 'léver af'. Further, the 'Kamma'-utterances can of course also be used to measure duration of initial and final 'Kamma's, with and without sentence accent.

The total of twenty utterances/dialogues were typed out on library index cards in three different randomizations, twice, numbered consecutively from 1 to 120.

Two speakers from Stockholm recorded this material, BjH who is a linguist (52 years, male) and ER who is a logopede (38 years, female). BjH was recorded in the silent studio at the Department of Linguistics, Stockholm University, with a Brüel & Kjær 4165 condensator microphone, Revox Studer B67 recorder, Scotch 208 Audio Tape, at 7½ ips. ER was recorded in a quiet booth at the Department of Speech Communication and Music Acoustics, Royal Institute of Technology, Stockholm, with a dynamic Sennheiser ND211N microphone, Revox A77 recorder, Scotch Audio 208 Tape, at 7½ ips. MD, a 28 years old student of linguistics and phonetics from Malmö (male) recorded the material in our quasi-damped room, with a Sennheiser MD21 condensator microphone, Revox A700 tape recorder, Agfa PEM369 tape, at 7½ ips. HD, a 33 years old student of linguistics from Malmö (male) was recorded in a quasi-damped room at the Department of Linguistics and Phonetics, Lund University, with a dynamic Sennheiser ND211 microphone, Revox Studer B62-2 recorder, Agfa PEM369 tape, at 7½ ips. The Swedish speakers recorded one pile of 60 cards twice.

C. THE COPENHAGEN RECORDINGS

A colleague (NRP, 45 years, male) and the author (NT, 42 years) recorded the material designed for southern Zealand, which means that place names, etc., have been adjusted. Otherwise, the recordings were done under the same conditions as MD (above), but we only recorded the 60 cards once. I have looked at data from NRP and myself often enough to judge both from hearing and vision whether a given item is typical or not, and there were no new elements in this material compared with previously analysed data from Copenhagen.

III. RESULTS

A. SENTENCE ACCENT

1. Auditory evaluation

The presence (or not) and location of sentence accents (SA) were ascertained while listening to the tapes and providing the mingograms with identification and proper text. I am the sole auditory judge in this case, but although certain shady cases might receive another verdict from other listeners, I have no doubt that the main trends will remain unchanged.

You will see from Table I that Bornholm speakers produced the isolated sentences without any extra perceived prominence anywhere in the utterances in 64% of the cases. Disregarding the insignificantly small proportions of non-invited initial, medial and double accents (2% each), we can say that the rest of the isolated utterances (30%) received a final SA. A contextually invited initial SA is rarely missed (90% were produced, plus 4% with a final SA as well, i.e. double accents). The majority of finally invited ones alse get realized (69% plus

a logarithmic one, with zero semitones equal to the lowest Fo value observed in the tracings of the given speaker, which meant that measurements were performed in semitones with an accuracy of ± 0.25 semitones for males and females alike.

Generally, Fo has been measured in a manner which will allow me in the average tracings to recreate confidentially the approximate course of Fo of the original ones. Thus, every onset and offset of voicing, as well as every turning point has been measured. And further points have been inserted to render falling and rising movements which were not linear but rather parabolic or asymptotic. Needless to say, items that are to be averaged must have the same number of measuring points in them, located at corresponding points across the tracings. The distance in time of each Fo-measuring point from the first one in each sentence/utterance was likewise measured. Averages over 6 (sometimes fewer) readings of each item were calculated, and average tracings drawn.

B. THE SWEDISH RECORDINGS

The sentences were translated into Swedish, as close-copy as possible:

(Vet du var Kamma är född?

Vem av dom är född i Svaneke?)

Kamma kommer från Svaneke.

(Var skall ungdomarna fira semester?

Vem skall till Sandvik förutom Anders?)

Anders och Kamma skall till Sandvik.

(Vad heter Torbens syster?

Vem har en syster som heter Kamma?)

Torbens syster heter Kamma.

Kofot och Torsson skall med bussen från Gudhem till Snogebäck klockan fyra på tisdag.

Hur långt är det från Sandvik till Svaneke?
Till Svaneke? - Det är cirka 3 mil.

De sista sillfiskarna får snart sluta.

Turisterna köper keramik for två miljoner kronor.

De tog fram kamrorna till nyår./ De tog kamrorna fram till nyår.[4]

De fick kannorna fyllda till kanten.

Hon fick kannan full med mjölk.

Kall mjölk släcker törsten.

En grå katt krafsar.

Turisterna fördubblar befolkningen på sommaren.

Många bornholmare lever på turisterna.

2. Speakers and recordings

Speakers were two women (HC and RK) and five men (IB, CA, HP, KP and JT) ranging between 37 and 55 years of age. Four of them are from Rønne, the largest town, situated in the south-west of Bornholm (CA, HC, IB, KP), two of them are from Nexø (on the east coast), and one (JT) from Gudhjem (on the north coast). - There seems to be a sharp distinction between the language spoken in Rønne and on the rest of the island, to the extent that non-Rønne speakers claim that in Rønne people do not even speak proper Bornholm. I thought it possible that this might also have prosodic reasons, which is why speakers were recorded from Nexø and Gudhjem, respectively.

The speakers were recorded in two sessions in the studio of a local radio station at Åkirkeby, with a Neumann U77 condensator microphone, Agfa PEM369 tape, a Revox A77 tape recorder, at 7½ ips.

There is a rather strong consciousness and a good deal of healthy pride among Bornholm speakers in speaking Bornholm. It was therefore not at all difficult to persuade the speakers that it was not their best imitation of Standard Danish of the capital I wanted on the tapes, but rather the closest approximation they could muster to the language they would speak among themselves, conforming, however, to standard morphology and syntax. They took a gratifying interest in the investigation, without being told specifically what the center of interest was for me, and they did not object either to having to read aloud from cards or to the somewhat absurd utterances, nor to having to read the material a total of six times. - During the instruction session they made lively comments to the sentences and discussed among themselves how such and such a word would be pronounced. This led to corrections on the spot of one or two words and to an agreement that minor morphological/syntactic adjustments away from the standard language were acceptable if the speakers could produce them spontaneously from the standard text. Due to an initial oversight, the person being recorded was heard over the loudspeakers in the control room. I was uncomfortable about this, but when I learnt that the only comments speakers ever made about each other's pronunciation concerned segments, never stress or intonation, I was actually quite content, granted that deviating prosody would have been much more prone to comments about 'funny accent' or the like.

3. Registration and measurements

The tapes were processed by hardware intensity and Fo meters (F-J Electronics) and registered on a mingograph (Elema 800) at a paper speed of 100 mm/s. By adjustment of the Fo meter's zero-line to the lower limit of the subject's voice range and full exploitation of the record space (about 80 mm) of the mingograph galvanometer, a measuring accuracy of 1 Hz for the males and 2 Hz for the females is attained. However, on the measuring rods, the linear frequency scale was transformed into

Table I

Number of sentence accents produced by seven Bornholm speakers in percentage of the possible maximum, determined a priori by the context (i.e. columns should add up to one hundred).

	Contextually invited sentence accents			
Sentences realized	None	Initially	medially	finally
Without SA	64%	1%	41%	21%
Initial SA	2%	90%	2%	0%
Medial SA	2%	5%	57%	1%
Final SA	30%	0%	0%	69%
Double SA	2%	4%	0%	9%

9% with double accents). The rest (21%) are lacking an SA. Only about half (57%) of the invited medial SA's actually get realized, the rest are missing (41%). There was only one sentence which invited a medial SA: 'Hvem skal til Sandvig foruden Anders? Ānders og Kāmma skal til Sāndvig.' It is not obvious to me that there is any semantic/pragmatic reason for the somewhat aberrant behaviour of this utterance, and it remains to be seen whether medial (or maybe rather: non-marginal) position is less prone to receive sentence accents generally, than initial and final ones. Speakers were not equally likely to produce SA's (whether invited or not). In a total of 54 Kamma-utterances (3 x 3 x 6) they produced perceptible sentence accents as follows: IB 49, HP 41, HC 40, KP and CA 31, JT 29 and RK 20.

It appears from the present material that sentence accent as a phenomenon exists in Bornholm but it is not obligatory, i.e. utterances may be produced without one. That is more likely to happen if the utterance is produced in isolation, but it may happen also where the theme/rheme distribution is quite clear from the context. (Note, though, that speakers rarely omit initial SA's.) When an isolated utterance nevertheless gets one, it hits the final lexical item. This gives substance to a common observation from English and Swedish, that every utterance must have at least one (nuclear) accent, and if nothing else is specified by the context, this accent will fall on the last lexical word.

The situation is different in Stockholm, on the one hand, and in Copenhagen and Skania, on the other:

Table II

Number of sentence accents produced by two Stockholm speakers in percentage of the possible maximum, determined a priori by the context (i.e. columns should add up to one hundred).

	Contextually invited sentence accents			
Sentences realized	None	Initially	medially	finally
Without SA	6%			
Initial SA		88%		
Medial SA		12%	100%	
Final SA	75%			94%
Double SA	19%			6%

Hardly any utterance is produced without an SA, and that can happen only to an isolated one (6%). As in Bornholm, an isolated sentence gets its SA finally (75%) if it is not supplied with a double (i.e. initial and final) sentence accent (19%). Double SA's can also occur where only a final one is invited (6%). Here is a case of misplacement: an invited initial accent gets located medially in 12% of the cases. The utterance responsible is 'Vem har en syster som heter Kamma? Tórbens sýster heter Kámma.' by speaker ER (three items). I tend to believe that the tediousness of the reading task resulted in a certain lack of attention which is responsible for the misplacement. Double accents and a misplacement apart, it is roughly true that every utterance is obligatorily supplied with a sentence accent, which gets located finally if the context does not specify otherwise. This is entirely in agreement with previous research on Stockholm Swedish, cf. Bruce (1977).

NRP (Copenhagen) did not produce a single instance which could lay any claim to being a sentence accent. The same utterances, produced in isolation and in context, are perceptually indistinguishable, as far as their origin is concerned. The author is the other speaker, and given this status, I am probably not a trustworthy subject for this part of the material, which plays heavily on a "naïve" speaker's interpretation. With this reservation, NT produced no final prominences in any

context. Utterances in contexts which invited initial and medial ones do not sound as if the rheme is especially prominent, but a certain down-grading of the preceding stress (medial rheme) and succeeding stress (initial rheme), respectively, can be discerned, which is probably sufficient for identifying the original context correctly, but the phenomenon has so little in common perceptually (and acoustically) with the sentence accents in Bornholm and Stockholm, that I hesitate to label it under this heading.

One of the two Malmö speakers, MD, resembles Copenhagen speaker NRP, except that all of his Kamma-utterances came out with a slightly more prominent second (middle) stressed word, relative to the initial and final ones, irrespective of utterance and context. The other Malmö speaker, HD, produced some unmistakable sentence accents in the appropriate contexts, though not invariably, but not in the isolated sentences, cf. table III. Note that, like the Bornholm speakers, HD produced fewer SA's in medial than in initial and final positions.

Table III

Number of sentence accents produced by a Malmö speaker in percentage of the possible maximum, determined a priori by the context (i.e. columns should add up to one hundred).

	Contextually invited sentence accents			
	None	Initially	medially	finally
Sentences realized				
Without SA	100%	59%	83%	67%
Initial SA		41%		
Medial SA			17%	
Final SA				33%

It appears, then, that sentence accent exists in Skanian but not as a default accent in isolated utterances and it is not obligatory in context, which is in agreement with observations by Gösta Bruce (personal communication) and Touati (1987).

Evidently, the material ought to be subjected to perceptual tests, where Bornholm, Stockholm, and Malmö listeners are given a choice between the various contexts to allocate spliced-out Kamma-utterances to. This is, however, a rather large enterprise which will have to be postponed, for the time being.

2. Fundamental frequency

The Fo traces should establish the acoustic foundation for my auditory impressions.

(a) Bornholm

The degree of uniformity across speakers is far from impressive, cf. figures 1-7, and I cannot organise the seven speakers consistently into sub-groups. This is not very satisfactory for whomever is trying to produce a clear and simple description of the manifestation of sentence accent in Bornholm, or for those who want to synthesize or automatically recognize Bornholm speech. However, this lack of uniformity cannot be explained away, and it is a good demonstration of the variability in speech production, which has come into the focus of phonetic research in later years.

There are two obvious ways to go about the description. I could outline the main trends as they appear across speakers, and note how and where individuals differ from those trends. I have chosen the other route, namely to account for one speaker first, and then note - in an annotated questionnaire-type table - how others follow or deviate from that pattern. HP is the one selected, for three reasons. Firstly his Fo range is large and he signals the difference between the different

Figures 1-7

Average fundamental frequency tracings (logarithmic display) by seven Bornholm speakers of three utterances with different sentence accent locations. Speakers are identified at the top left of each figure, as is the frequency value which is the basis for the conversion to semitones. The number of items behind each average tracing is given at the top right of each subpart of the figures. Utterances with no perceived sentence accent are traced in full lines, utterances with perceived initial sentence accent in dotted/broken lines, utterances with perceived medial sentence accents in dotted lines, and utterances with perceived final sentence accents in broken lines. Speakers HP, IB and JT produced such perceived final accents partly when provoked by the textual context (heavier broken lines), partly in isolated utterances (thinner broken lines). Note that HP (figure 1, bottom) produced '-ter hedder' with unvoiced [h] *in the full and broken line editions, creating 6 bits of tracing, as opposed to the five bits in the dotted/broken line, where '-ter hedder' was produced with unbroken voicing. JT (figure 4, bottom) consistently produced '-ter hedder' in two bits. Note also that CA (figure 7) produced 'Kamma stammer fra Svaneke' (top) with secondary stress on 'stammer'.*

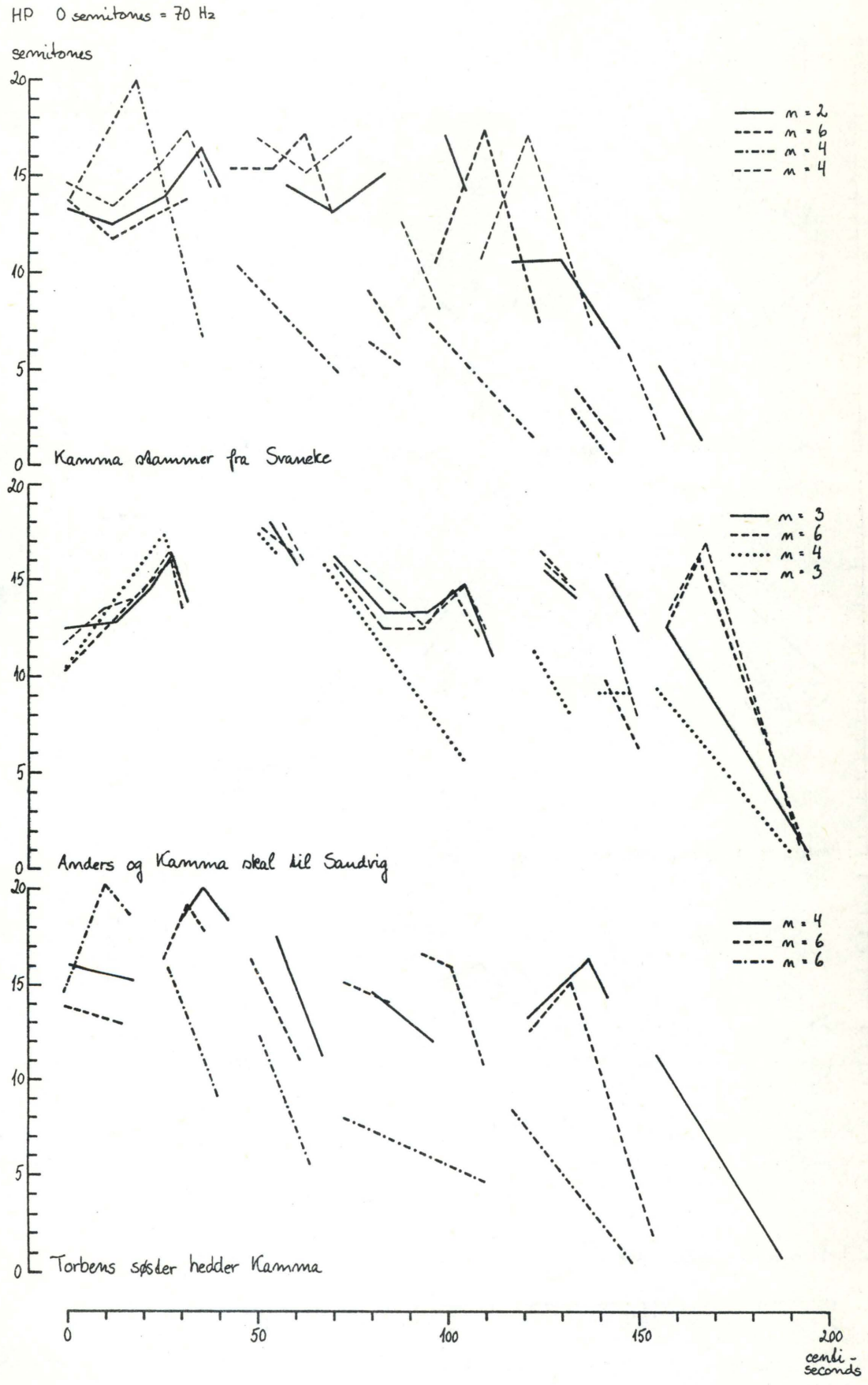

HP 0 semitones = 70 Hz
semitones
20
15
10
5
0
n = 2
n = 6
n = 4
n = 4
Kamma skammer fra Svaneke
n = 3
n = 6
n = 4
n = 3
Anders og Kamma skal til Saudvig
n = 4
n = 6
n = 6
Torbens søsder hedder Kamma
0
50
100
150
200
centi-seconds

Figure 1

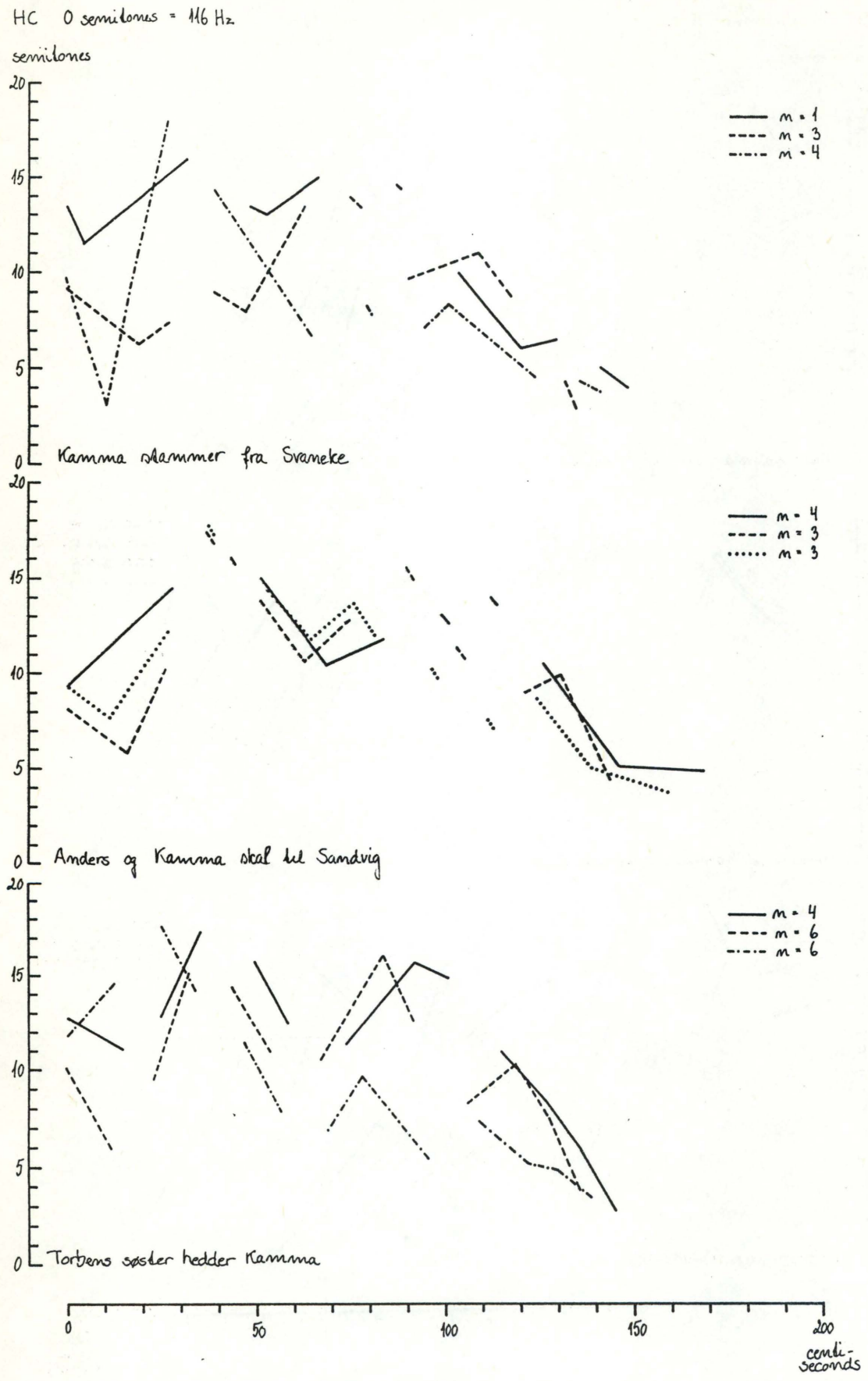

HC 0 semitones = 116 Hz
semitones
20
15
10
5
0
m = 1
m = 3
m = 4
Kamma skammer fra Svaneke
m = 4
m = 3
m = 3
Anders og Kamma skal til Sandvig
m = 4
m = 6
m = 6
Torbens søster hedder Kamma
0
50
100
150
200
centi-seconds

Figure 2

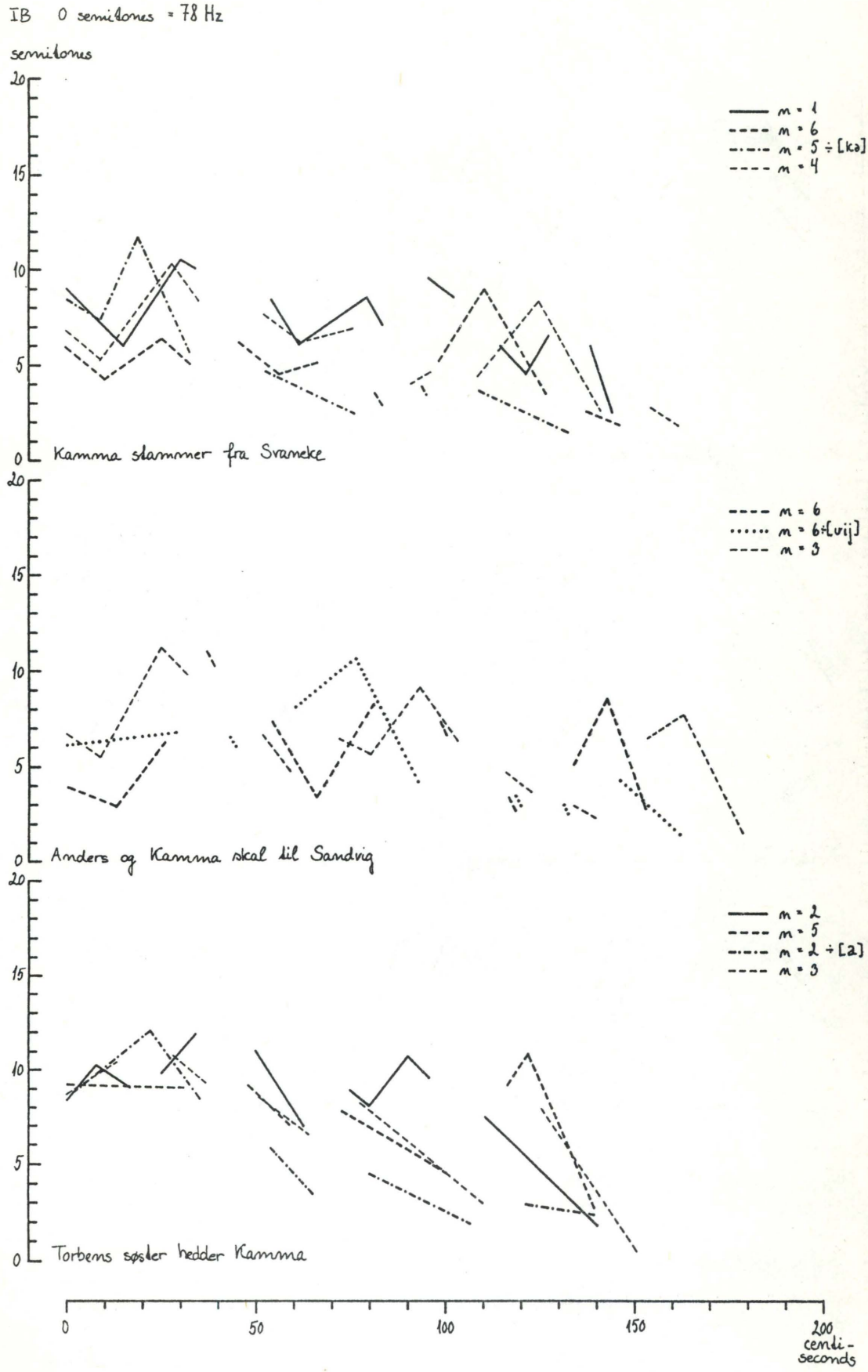

IB 0 semitones = 78 Hz
semitones
20
15
10
5
0
m = 1
m = 6
m = 5 ÷ [kə]
m = 4
Kamma slammer fra Svaneke
m = 6
m = 6÷[vij]
m = 3
Anders og Kamma skal til Sandvig
m = 2
m = 5
m = 2 ÷ [ɔ]
m = 3
Torbens søster hedder Kamma
0
50
100
150
200
centi-seconds

Figure 3

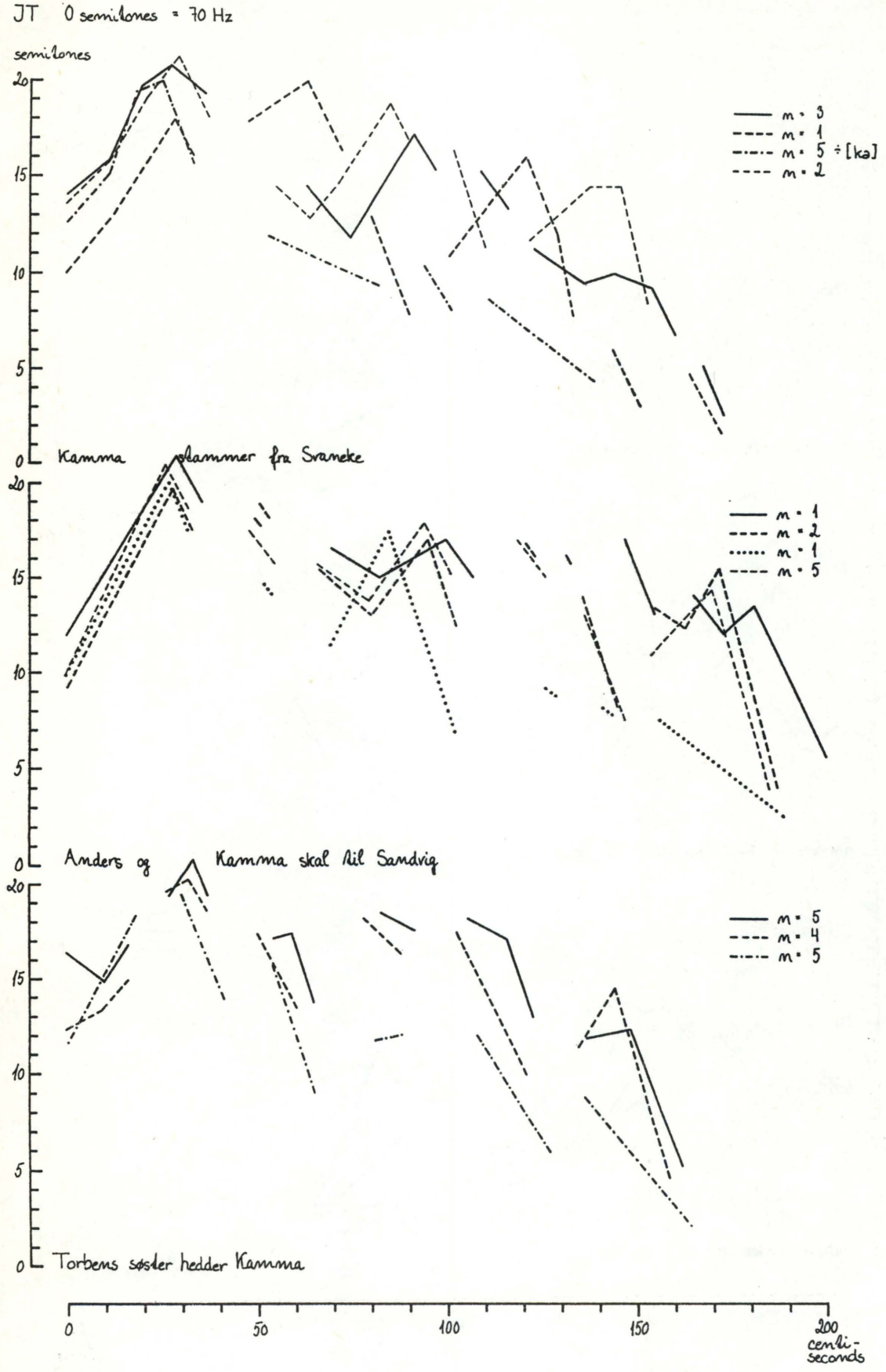

JT 0 semitones = 70 Hz
semitones
20
15
10
5
0
m = 3
m = 1
m = 5 ÷ [kə]
m = 2
Kamma klammer fra Svaneke
m = 1
m = 2
m = 1
m = 5
Anders og Kamma skal til Sandvig
m = 5
m = 4
m = 5
Torbens søster hedder Kamma
0
50
100
150
200
centi-seconds

Figure 4

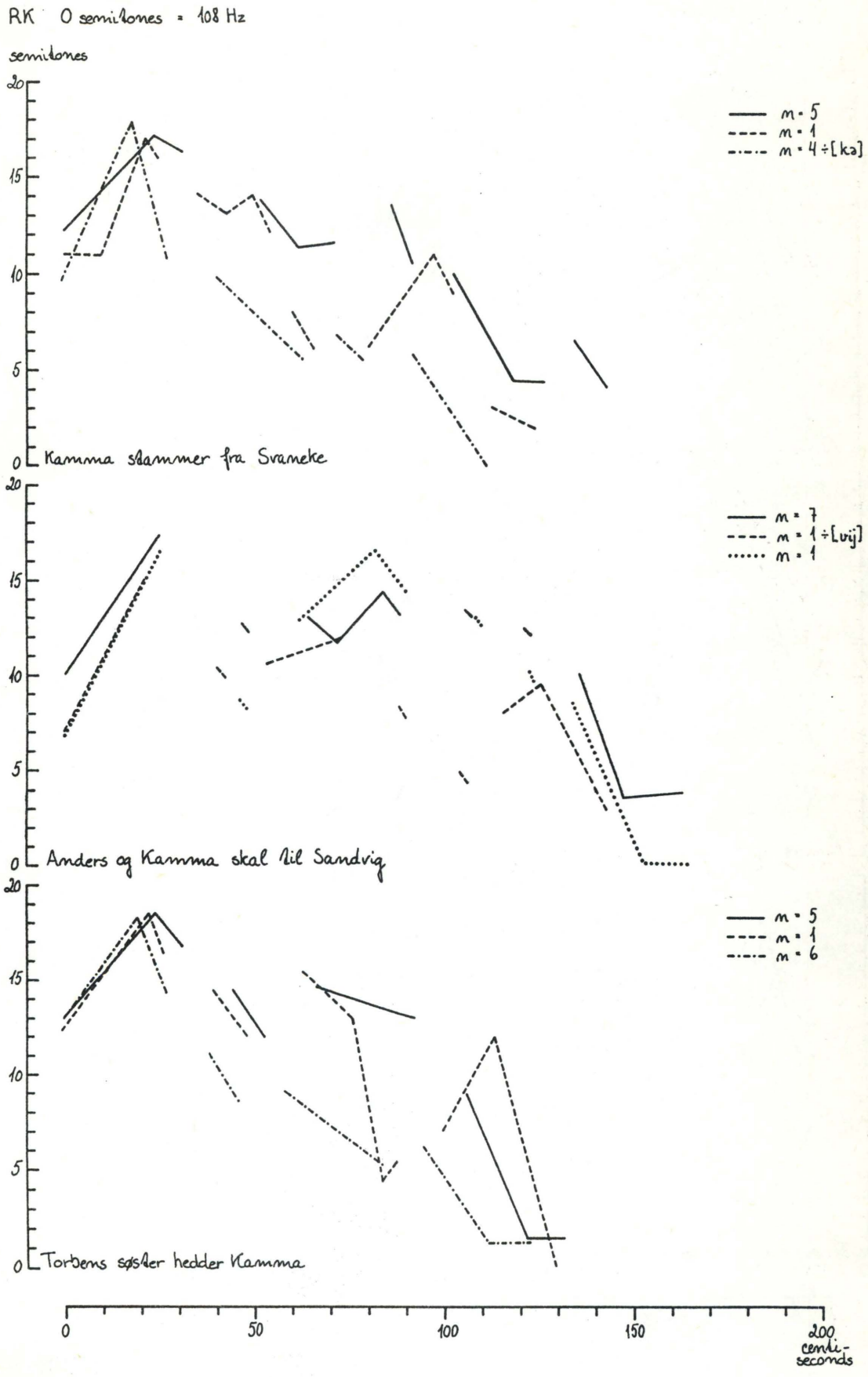

RK 0 semitones = 108 Hz
semitones
20
15
10
5
0
m = 5
m = 1
m = 4 ÷ [ka]
Kamma skammer fra Svaneke
m = 7
m = 1 ÷ [vij]
m = 1
Anders og Kamma skal til Sandvig
m = 5
m = 1
m = 6
Torbens søster hedder Kamma
0
50
100
150
200
centi-seconds

Figure 5

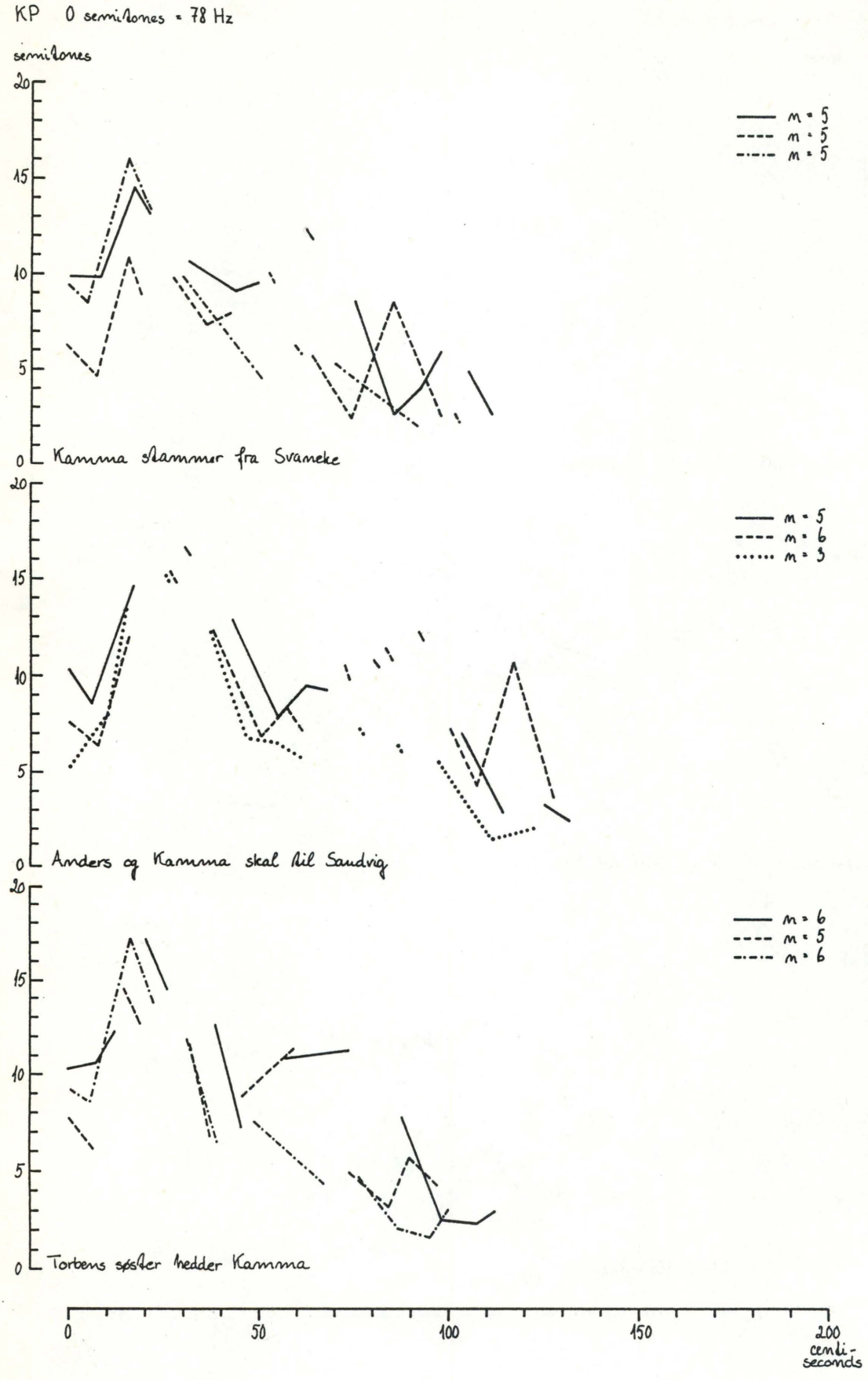

KP 0 semitones = 78 Hz
semitones
20
15
10
5
0
n = 5
n = 5
n = 5
Kamma skammer fra Svaneke
n = 5
n = 6
n = 5
Anders og Kamma skal til Saudvig
n = 6
n = 5
n = 6
Torbens søster hedder Kamma
0
50
100
150
200
centi-seconds

Figure 6

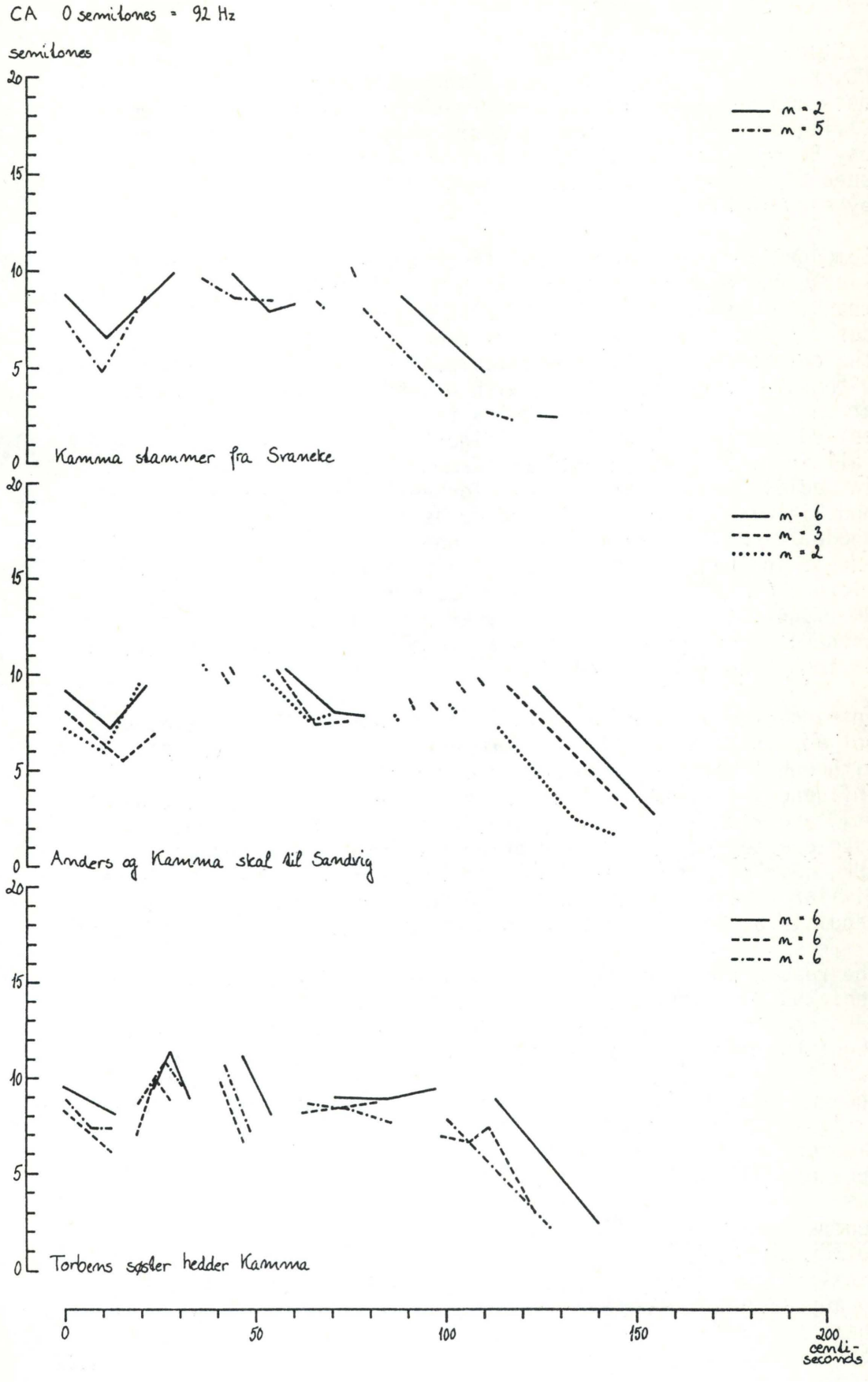

CA 0 semitones = 92 Hz
semitones
20
15
10
5
0
m = 2
m = 5
Kamma stammer fra Svaneke
m = 6
m = 3
m = 2
Anders og Kamma skal til Sandvig
m = 6
m = 6
m = 6
Torbens søster hedder Kamma
0
50
100
150
200
centi-seconds

Figure 7

editions of each utterance generously and explicitly. Secondly, he produced a large number of utterances with sentence accent (76% of the possible total). Thirdly, he is (together with HC, CA and IB) judged to have attained a high degree of naturalness and authenticity (i.e. approaching a spontaneous speech style) by a colleague who is thoroughly familiar with present-day Bornholm speech (Mogens Baumann Larsen, Aalborg, who has been kind enough to listen to and comment the first 20 items by each speaker).

Some preliminary remarks abut the figures are called for, to single out minor deviations which I will assume have no bearing upon the issues at hand, and which I shall disregard in the description to follow. The numerous obstruent consonants at the onsets and offsets of syllables have a marked effect on Fo with some speakers, but not with others. It suffices to look at the full lines in the figures (the utterances with no perceived sentence accent). HP (figure 1) has a small and brief fall in Fo finally in initial 'Kamma', in initial 'Anders', in medial 'Kamma', in initial 'Torbens' and in medial 'søster', and likewise in the unstressed words 'fra, og, skal, til, hedder'. HC (figure 2) exhibits none of these final drops, except in 'hedder', nor does CA (figure 4) except in initial 'Torbens'. JT (figure 5) resembles HP; and IB (figure 3), RK (figure 6) and KP (figure 7) are in between, i.e. if and when Fo drops before or after an unvoiced obstruent, the effect is less than with HP and JT.

Intrinsic Fo differences between different vowel qualities do not appear to have had a uniform effect across all speakers. Although I have tried to keep all vowels low, to minimize this influence, 'Svaneke' has a high vowel in its first post-tonic, [ɪ], and with HC (figure 2) and JT (figure 5) that seems to have created an upwards deviation from what other speakers (HP, CA, RK) perform as a more or less straight fall in 'Svane-'. Similar remarks about segmental effects pertain, mutatis mutandis, to the utterances with sentence accent.

The reader might reasonably protest that I should have compensated for these effects, erased them in the tracings. I have chosen not to, for two reasons. One, not enough is known about the magnitude, the quantification, of coarticulatory variations in Fo at segment boundaries. Two, it is interesting enough, per se, to observe the rather impressive inter speaker variability in this area, to merit its preservation in the figures. - In the final schematized model of the Bornholm speakers, segmental effects have been left out, of course.

Neutral, no perceived accent edition (figure 1, top, mid, bottom, full line): Common to the three utterances are pre-final stress groups at a fairly high Fo level, exhibiting hardly any declination or downdrift. The final stress group (in these terminal declaratives) is steeply falling, covering a range of about an octave. Note that this fall, extensive as it is, did not trigger the perception of any particular prominence, presumably because it is ascribed to the terminal delarative function of the utterance.

The two pre-final stress groups are of the low (falling)-high (rising) type, whereas the final one reverses the pattern into a high-low type. (I shall return to this point in section III. C.) Note that the rise stretches over all of the post-tonics, i.e. its peak is reached only at the end of the stress group, which means that the slope of the rise varies, compare, e.g., 'Tórbens' to 'søster hedder' at the bottom of figure 1. See also further below.

Final perceived sentence accent (figure 1, top, mid, bottom, broken lines): HP (and IB and JT) produced enough isolated sentences with a perceived final sentence accent to justify their inclusion in the figures. They are drawn with the same type of line, only thinner, as the examples with final sentence accent invited by the context. Final accent triggered by the context (thicker broken lines): these three utterances deviate from the neutral ones in that the final fall is larger and quicker/steeper, beginning as it does after a rise to a frequency near the top of the speaker's range. The high onset of the final fall is accentuated by the comparatively low preceding unstressed syllable, which is another difference from the neutral edition: the pre-accentual stress group gets its tail end twisted downwards after a brief and modest rise from its stressed syllable. (I shall return to this point in section III.C.) The first stress group is roughly unaffected by the sentence accent at the end. The final, provoked sentence accent shortens the whole utterance with initial and final, but not medial, 'Kamma'. This is where the isolated utterance with (final) sentence accent differs (thinner broken lines): it is longer than the utterance with a preceding context (except where medial 'Kamma' is concerned). There are several issues involved here, and the durational data are not straightforward to interpret. Duration will be treated separately below in section 3.

Initial perceived sentence accent (figure 1, top and bottom, dotted/broken lines): The initial stress group performs a more ample movement, with a reversed pattern (compared with the neutral), i.e. a high (rising)-low (falling) one. The rest of the utterance performs a smooth and asymptotic, continuous fall to the low end, i.e. stress group patterns are suppressed or deleted after the sentence accent. (The minor deflections from a completely smooth downward course seen in figure 1 can be ascribed to segmental effects.) Thus, the terminal fall, which was a very local, final phenomenon in the neutral and final sentence accent editions is distributed over all of the non-initial part of the utterance with initial sentence accent.

Medial perceived sentence accent (figure 1, mid, dotted line): The most predominant feature is a considerable fall in the stressed syllable, i.e. a high-low pattern, but the second and third post-tonics actually do rise slightly (and probably more than can be attributed to segmental effects) from the low offset of the fall in the stressed plus post-tonic syllables. The other speakers conform better, however, to the pattern set by initial SA's: that Fo steers a smooth downward course after

the sentence accent, and I shall assume that that is the pertinent description, generally. The initial stress group, again, bears no witness of what follows, and the onset of the fall of the medial sentence accent is furthermore coincident in frequency with the onset of the medial stress group in the neutral and final-sentence-accent editions.

To simplify and sum up (figure 1): The neutral edition of these short terminal declarative utterances has high and level (relative to each other) low-high stress groups, preceding a final high-low stress group which performs a considerable fall. A final sentence accent demonstrates a larger and quicker falling movement, which is put into relief by the falling tail of the preceding stress group. It has no effect on earlier parts of the utterance. Initial and medial sentence accents likewise involve a larger and reversed (i.e. high-low) stress group pattern and a suppression of succeeding ones, which fall gently to the end of the utterance.

The accent-less utterances are treated more or less uniformly by all speakers according to figures 2-7 and table IV. There is also a near-unanimity about constant utterance onsets (in these utterances which are all of approximately the same length) and offsets. KP's and IB's final stress groups deviate from the rest in final 'Svaneke', with their fall-rise-fall, as opposed to the nearly clean fall in the final stress groups in the rest of the material. Whether this deviance is to be seen as an attempt at a preservation of the otherwise prevalent fall-rise with a final fall added for terminal declarative purposes (a pattern which is truncated (from the beginning) when the stress group is shorter, as in 'Sandvig, Kamma') is not possible to tell, given the scarcity of the material. - Total range spanned commonly exceeds 15 semitones, but may be more modest (IB and CA).

Apart from CA, who will be treated below, and apart also from the ripple caused by exceptions to a trend and by ambiguity in the acoustic signal, it seems that there are two ways to go about putting the sentence accent into relief: HP, IB, JT, and RK lower the offset of the preceding stress group pattern by twisting its tail downwards at the end, and upstep the onset of the accentuated item (relative to the neutral utterance) thus creating a sharp jump upwards to the beginning of the high and extensive accent fall. HC and KP (and CA) do the opposite: by tilting the global intonation contour into a rising shape leading up to the sentence accent (i.e. by lowering the initial stress group(s)), and by maintaining the rise (or even increasing its peak) in the immediately preceding pattern, the sentence accent fall - even though of comparatively modest extent - is made prominent. Only two speakers make consistent use of the possibility to reverse the low-high stress group pattern in non-final sentence accents (HP and IB, see further section III.C.).

Table IV - see the text

	HP	HC	JT	RK	KP	IB	CA
Utterances without sentence accent							
Non-final stress groups are Low-High	+	+	+	+	+	+	+
Final stress groups are High-Low	+	+	+	+	+ but Svaneke has an added High-Low	+ but Svaneke has an added High-Low	+
Terminal declarative sentence intonation is signalled locally, at the end, i.e. the contour is high and level until the final drop or fall in frequency	+	+	+	+	+ but not with final Kamma	+ but not quite unambiguously with Svaneke	+
All utterances end equally low (within one or two semitones)	+	+	+	+ but only with final Kamma	+	+	+
All utterances begin equally high (within one or two semitones)	+	+	+	+	(+)	(+)	+
Total range spanned in semitones	20.2	15.0	19.4	18.5	15.9	10.2	9.6
Number of utterances produced with SA, in percentage of the possible 54 total	76	74	64	37	57	91	57
Utterances with sentence accent							
The tail of the pre-accentual stress group is twisted downwards	+ but not initially	- (only before Sandvig)	+	+	-	+	-
After the SA peak Fo steers a smooth, undeflected downward course through the rest of the utterance	+ but the medial SA preserves a rise	+	+	+	+	+	-
Stress groups preceding the SA are tilted downwards, relative to the neutral edition	-	+	-	(+)	+	+ and their pattern may be reduced/deleted (not with Sandvig)	+
Final SA's have an inverted, i.e. High-Low pattern	+	+	+	+	- the pattern is Low-High-Low	+	+
Non-final SA's have an inverted, i.e. High-Low pattern	+	-/+	-/+	+ but not unambiguously	-	+	-
SA's have a larger Fo movement	+	- (only initial Kamma)	+ not initially	+ but not unambiguously	- only with Sandvig	+ but only finally	-
SA's have quicker Fo movements	+	+ (slightly)	+ but not initially	+ but not unambiguously	+ but not unambiguously	+ especially finally	+ but not unambiguously
Utterances with SA are shorter than the neutral edition	+ but not much with Sandvig	+ considerably only with Sandvig	+/- unambiguously only with initial Kamma	+/- unambiguously only with initial Kamma	+	-	+

CA (figure 7) stands out from the other speakers, not just with a modest Fo range but particularly where the signalling of sentence accent is concerned. He produces none of the special effects, except that the intonation contour leading up to the sentence accent is tilted, and the accent itself may have a somewhat quicker movement. His sentence accents all sounded decidedly weak, i.e. not very prominent, although identifiable. With some utterances matters were helped by a brief pause after the accentuated item.

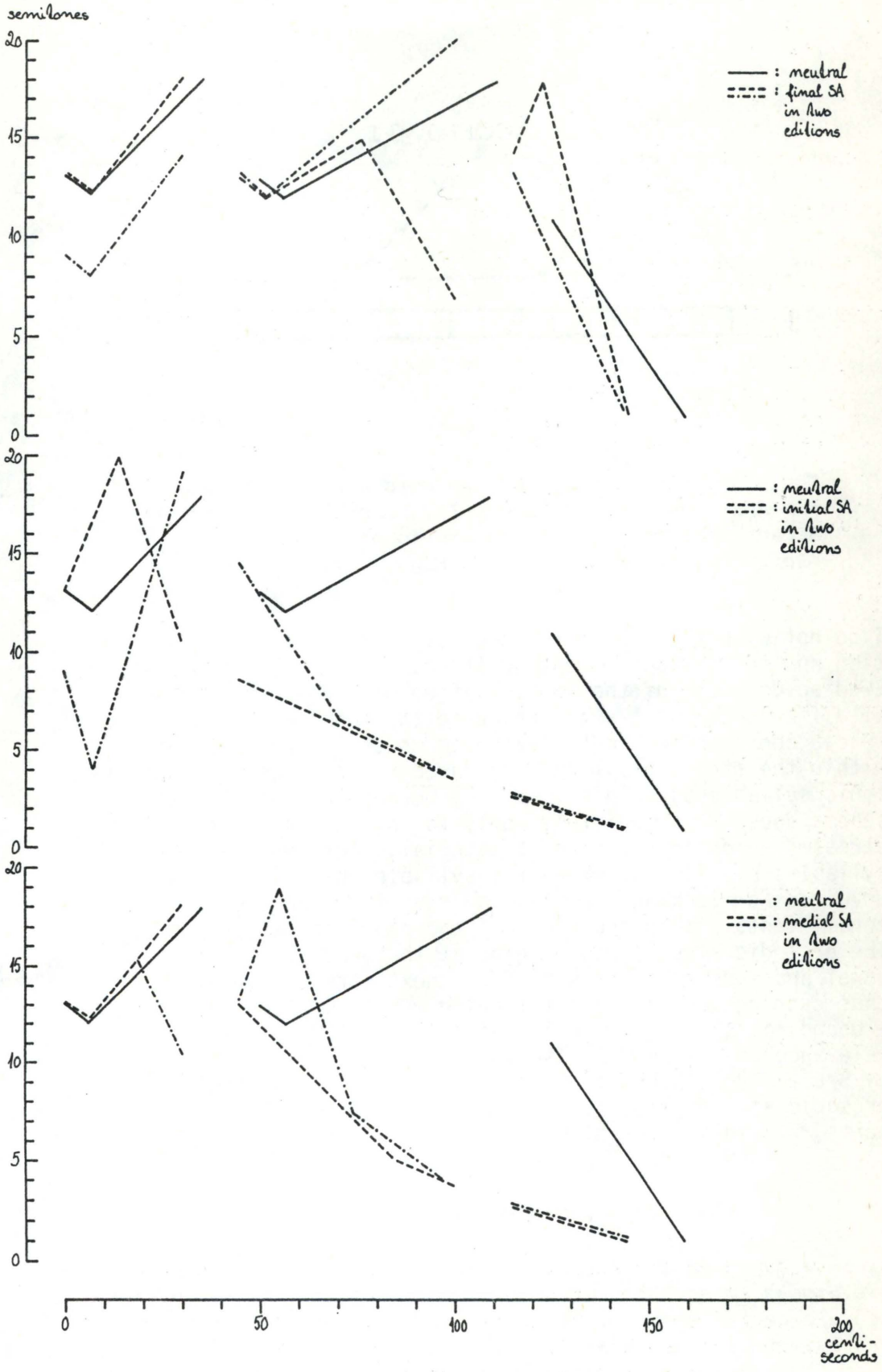
Figure 8 summarizes the results graphically. It shows how a difference in stress group length influences the slope of the rise from the low turning-point, and also the two different ways to make the sentence accent stand out from the surroundings. - It would have been interesting to know what governs these two different behaviours - whether they express different "readings", i.e. whether listeners would attribute them to different pragmatic contexts, or whether they really are equivalent options for speakers to choose from. As mentioned above, the perceptual tests that would clarify this issue are a large-scale affair, and will have to await future research.

(b) Stockholm

This section will mainly concern those aspects which are pertinent to a comparison with the Bornholm material. Readers are referred to Bruce (1977, 1982), Gårding (1977) and Bruce and Gårding (1978) for a thorough treatment of Swedish word tones and intonation. However, I should point out that I depart from the there established way to account for the difference between the two tonal word accents in Swedish. Figure 9 from Bruce (1977) illustrates his description of the Accent I/ Accent II contrast in its canonical form, i.e. when no sentence accent and no terminal juncture interfere: the distinctive feature is the fall in Fo, which is aligned with the prestressed syllable in Accent I (invariably) and with the stressed syllable in Accent II (where the exact timing may vary somewhat with position in the utterance). The Accent I fall is somewhat steeper than the Accent II fall. For both word accents the fall is preceded by a rise from the vowel preceding the pre-stress and the stressed vowel, respectively. -

Figure 8

Stylized fundamental frequency tracings (logarithmic display) of Bornholm utterances with no perceived sentence accent (full lines) and utterances with contextually provoked perceived final, initial, and medial (top to bottom) sentence accents, based on the data in figures 1-7. Two possible strategies for high-lighting the sentence accents are indicated (broken lines versus dotted/broken lines).


semitones
20
15
10
5
0
——— : neutral
– – – : final SA in two editions
——— : neutral
– – – : initial SA in two editions
——— : neutral
– – – : medial SA in two editions
0
50
100
150
200
centi-seconds

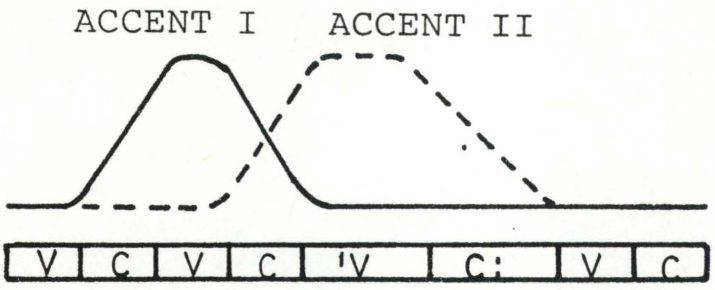


Figure 9

The basic contours of the two word accents. Schematized Fo-contours of accent I (unbroken line) and accent II (broken line) in pre-focal position. (Reproduced from Bruce 1977, Figure 17.)

I do not wish to dispute the general adequacy of this description and the obvious advantage it has for the comparison across Swedish dialects of the manifestation of the Accent I / Accent II difference, but I shall refer to the tonal patterns of the word accents in this material in terms of the Fo movement within the stressed syllable or through the stressed and post-tonic syllable(s). This is partly because Bruce's (1977) schema does not immediately apply to the utterance initial stressed words in the present material, where no unstressed syllables precede and where the syllable initial consonant is unvoiced (or lacking), partly in order to bring the significant tonal events within the realm of the prosodic stress group: The prosodic stress group begins at the onset of the stressed vowel and ends at the onset of the next stressed vowel, thus cutting across any intervening word - or higher syntactic - boundaries, see further Thorsen (1980a, 1982, 1984). The relevance of this unit, also for Swedish, is explicitly stated by Bruce (1982, p. 56). Strangert (1983) showed how the prosodic stress group is the unit within which temporal adjustments in Swedish take place.

Figures 10 and 11

Average fundamental frequency tracings (logarithmic display) by two Stockholm speakers of three utterances with different sentence accent locations. Final sentence accents invited by the textual context are drawn in heavier broken lines, final sentence accents produced in utterances in isolation are drawn in thinner broken lines. The word accents are identified in Arabic numerals above the stressed vowels in the sentences. See further the legend to figures 1-7. Note that ER produced 'Kamma kommer från Svaneke' with unstressed 'kommer'.

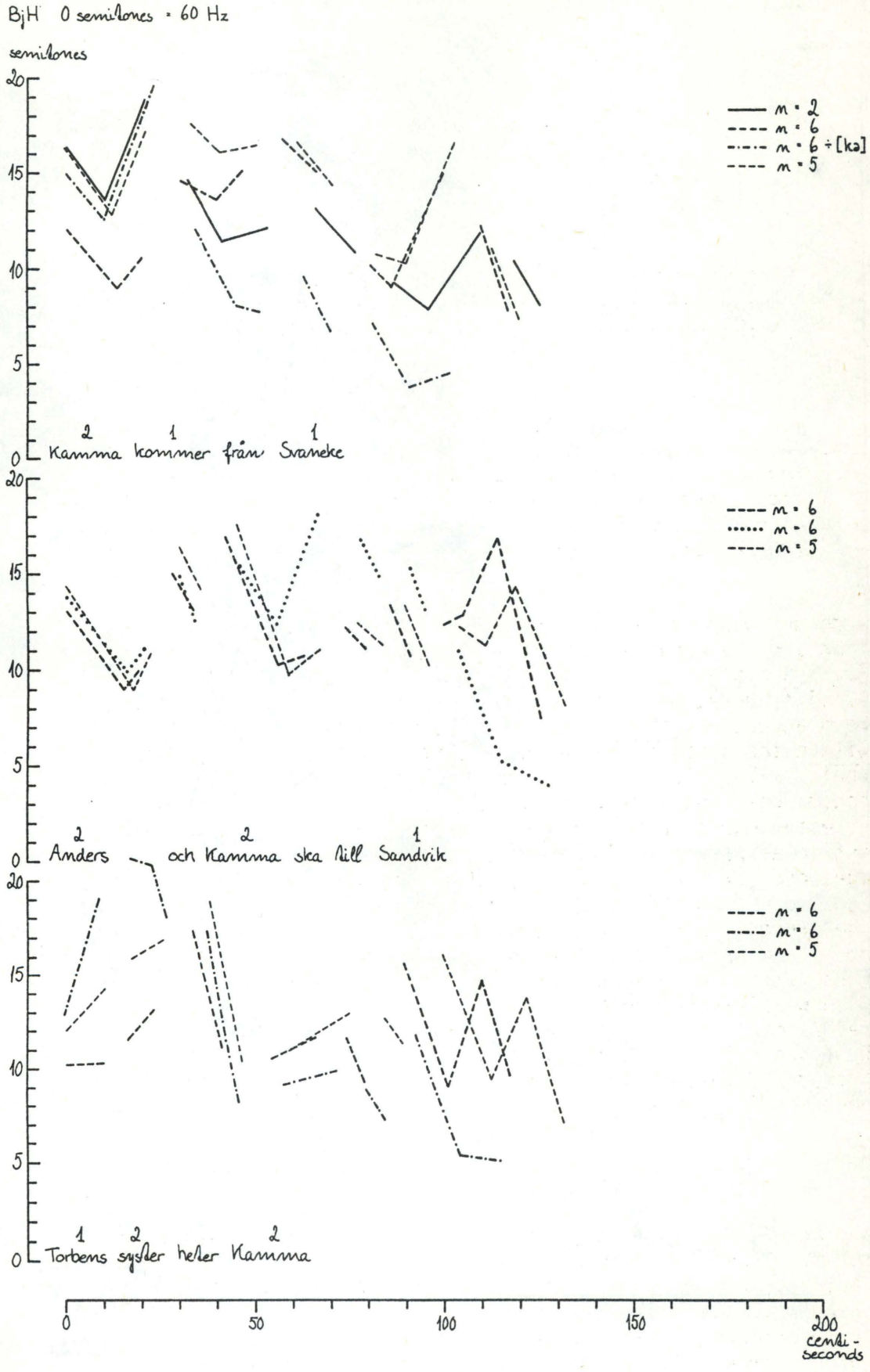

BjH 0 semitones = 60 Hz
semitones
20
15
10
5
0
m = 2
m = 6
m = 6 ÷ [ka]
m = 5
2 1 1
Kamma kommer från Svaneke
m = 6
m = 6
m = 5
2 2 1
Anders och Kamma ska till Sandvik
m = 6
m = 6
m = 5
1 2 2
Torbens syster heter Kamma
0
50
100
150
200
centi-seconds

Figure 10

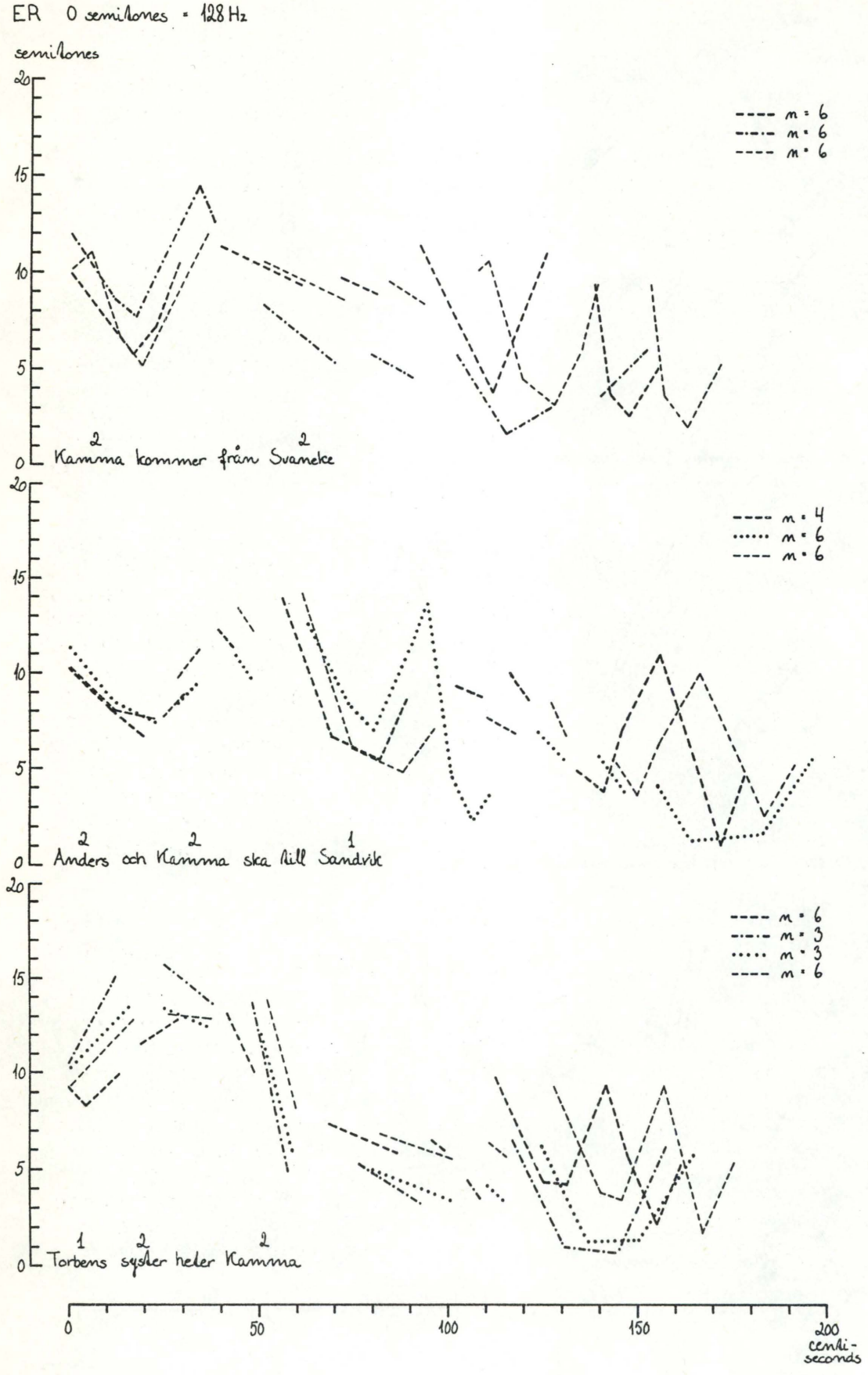

ER 0 semitones = 128 Hz
semitones
20
15
10
5
0
---- n = 6
-·-·- n = 6
---- n = 6
2 2
Kamma kommer från Svaneke
---- n = 4
····· n = 6
---- n = 6
2 2 1
Anders och Kamma ska till Sandvik
---- n = 6
-·-·- n = 3
····· n = 3
---- n = 6
1 2 2
Torbens syster heter Kamma
0
50
100
150
200
centi-seconds

Figure 11

Accordingly, I shall refer to the Accent I pattern in Stockholm (in this material) as rising(-falling in the post-tonic) and Accent II as falling(-rising in the post-tonic), which is how the stressed (plus post-tonic) syllable(s) appear(s) in, e.g., the first word in each of the three utterances with final SA in figures 10 and 11. This is reminiscent of the way the word accents in Stockholm Swedish were described by scholars previous to Bruce (1977), except that the added/superposed influence of the sentence accent upon the word accent was not separated out by, e.g., Gårding and Lindblad (1973) and Gårding et al. (1974), who had looked at one-word utterances. (Note, incidentally, that just like some words in Danish receive stød by some speakers but not by others, the four Swedish speakers do not agree about the accent on 'Kamma, Svaneke, syster'. This is partly a question of dialect, partly idiolectal. Word accent identification is given above the stressed words in the figures (10-13). Note also that when 'kommer' and 'heter' are de-stressed (as they are with a few exceptions), they carry no autonomous Fo pattern but behave tonally as the tail to the preceding stress group.)

There is only one utterance (two recordings) without any perceived sentence accent ('Kamma kommer från Svaneke.' by BjH, figure 10, top, full line). It differs from the corresponding neutral utterance by six of the seven Bornholm speakers, where the pre-final stress groups were high and on a level with each other, preceding an extensive final fall. Here, the fall is evenly distributed over the three stress groups, and none of them has a more extensive Fo movement than the other, resembling the Standard Danish way to render such utterances, cf. figures 14 and 15,(and KP from Bornholm), cf. below. However, two items of one utterance by one speaker is hardly sufficient to conclude anything about intonation where no sentence accent is present, which furthermore seems to be happening only very rarely in Stockholm Swedish.

The isolated utterances which received (final) sentence accent are shown here (thinner broken lines) together with utterances where the context invited one (heavier broken lines). Although they fit the same overall pattern, there are two notable differences: utterances with an invited final accent are shorter than the corresponding isolated ones, by around 10%, see further below. Note that the isolated utterance at the top of ER's figure (11, the thin broken line), had initial and final sentence accent. With BjH there are two instances (top and bottom) where the invited final accent has caused the initial stress group to get its level/movement lowered/diminished, respectively, a trend also noted by Bruce (1982, p. 75). It remains to be seen whether such differences would provoke different answers from listeners asked to provide a context for these utterances.

The possibility of inverting a stress group pattern for highlighting purposes, which seems to be the rule for final sentence accents in Bornholm and an option for pre-final ones, is ruled out in Stockholm (and Malmö) because the identity of the word accents must be preserved.

There are a number of similarities, however, between the Bornholm and the Stockholm utterances: An initial and medial sentence accent suppresses or deletes succeeding Fo movements, and the terminal declarative sentence intonation gets expressed through the fall from the peak of the accent to the end of the utterance. (The utterance final rise, exhibited by ER, is not, I think, a contradiction to this statement. It is characteristic of a certain speech style, which - inter alia - signals an obliging and favourable disposition towards the listener, cf. Bruce (1977, p. 58).) Final sentence accent does not delete or suppress Fo movements in preceding stress groups, although two of BjH's utterances have a certain lowering/diminishing of the first stress group.

The Stockholm word accents maintain their characteristic movements before and in sentence accent position, which is entirely in accordance with Bruce (1977). It is less conspicuously the case in post-accentual position. Bruce (1977) showed that word accents maintain their perceptual identity also post-focally, which I do not wish to dispute, especially since I have not run the necessary perceptual tests on this material. It IS possible, also here, to postulate a difference in the manifestation, partly in the post-accentual stressed word itself, partly in its relation to the preceding Fo course. With BjH final 'Kamma' (Accent II) should be compared with final 'Svaneke' (Accent I), in the utterances with initial sentence accent (dotted/broken lines). The fall in 'Kamma' is more comprehensive and starts from an onset which is higher than the preceding unstressed syllable, as opposed to the slight fall in 'Svaneke' which is preceded by a higher unstressed syllable. With ER, final 'Kamma' after medial sentence accent should be compared with final 'Sandvik', and the same description can be maintained, though it may be somewhat forced. This brings the manifestation on a par with Bruce's (1977) accent description (thus attesting its more general appropriateness), insofar as one could say that the post-SA Accent I words (even though falling themselves) are also preceded by a fall from an unstressed syllable ('early fall'), whereas the (falling) Accent II words constitute the onset of a fall (with a rise from or on a level with the preceding unstressed syllable, 'late fall').

BjH and ER differ in the way they treated the medial, invited sentence accent (figures 10 and 11, mid). ER produced the utterance in two phrases, i.e. her 'Kamma' is phrase-final and (therefore) resembles her utterance final, accented 'Kamma' where the terminal declarative fall is contained within the post-tonic '-ma'. Note, then, that the second phrase ('skall till Sandvik') is produced <u>without</u> any sentence accent. ER

produced three misplaced medial accents in 'Torbens syster heter Kamma.', and this did not trigger any prosodic phrasing, but these utterances are curious by their lack of any rise to signal the sentence accent (compare this with BjH's medial accent in 'Anders och Kamma skall till Sandvik'.). It is, of course, possible that ER produced ambiguous utterances, or that I perceive them incorrectly, but I cannot hear any prominence on 'Torbens' (which was what the context invited), and nor is 'Torbens' as high rising in the dotted as in the dotted/broken edition. It remains to be seen whether Swedish listeners will assign a medial rhematic focus to ER's 'syster' in spite of its lack of any sentence accent manifestation. IF such is the case, and IF this type of utterance is not very uncommon (but these are big IFs), then there is room for speculation about the nature of rheme or focus (which is not, then, necessarily signalled through the tonally prominent sentence accent) versus sentence accent (which does not necessarily signal a contextually determined rheme/focus, as it does not in final position in isolated utterances. I shall return to this question below, in section 3.)

A few more points are worthy of notice. ER produced two perceptible sentence accents in isolated 'Kamma kommer från Svaneke.' As opposed to the final one only, invited by the context. The difference between initial 'Kamma' with and without sentence accent is not considerable, but the fall is steeper under SA and the rise somewhat higher, and 'Kamma' is longer. It compares well with the invited initial sentence accent, though it is lower in the Fo range. As also noted above, BjH differs in the way he renders the final sentence accent in isolated versus contextualized utterances: at the top and bottom of figure 10 it appears that the invited final SA implied a lowering of initial 'Kamma' and 'Torbens', respectively. Not so with initial 'Anders', but here the invited sentence accent at the end performs a more ample movement than the uninvited one. Together with the trends set by the durational data (see below), this does inspire further investigations into a possible dichotomy between syntactic/prosodic sentence accents, and semantic/pragmatic ones.

According to Bruce (1977) and Bruce and Gårding (1978), the rise in Accent II words (which caused the postulate in older descriptions of a double-peaked Accent II versus the single-peaked Accent I in Stockholm Swedish, cf. Gårding and Lindblad (1973) and the references therein) is due to the sentence accent. I cannot entirely agree, since the rise is also clearly present (although it is not as high) in Accent II words in the position before a (medial or final) sentence accent. It is true, however, that in post-SA position what remains is the fall in the stressed syllable (see BjH's 'syster heter Kamma' at the bottom of figure 10, and cf. Bruce (1982, p. 61 and p. 78).) (The final rises with ER are not, as noted above, a contradiction, occurring as they do in the final part of the post-tonic vowel (rather than at the offset of the stressed one), and being generalized also to Accent I words in prepausal position, and to final sentence accents, where they are

tagged on to the terminal declarative fall.) Insofar as the rise in Accent II words is not attributable exclusively to the influence of an SA command after the word accent command, it may not be quite pertinent to state, as Bruce (1979) and Gårding (1978) do, that final SA in Stockholm comes after the word accent, but rather that it reinforces the final, rising, part of it. And THAT would bring Stockholm on a par with Malmö, where SA is said to be superposed on the word accent, increasing its range. See further below about Malmö, though.

(c) Malmö

The speakers from Malmö (MD and HD, figures 12 and 13) conform exactly to what is known already, cf. Bruce and Gårding (1978) and Touati (1987): the word accent patterns are reversed: The typical Accent II pattern in Stockholm, the fall(-rise), is the Accent I pattern here, though the pattern does not rise but stays low and level on the post-tonics, and vice versa, the typical Accent I pattern in Stockholm, the rise(-fall), is the Accent II pattern here. There would be no problems here with a description in terms of an earlier (I) versus later (II) Fo fall in the Malmö data.

MD produced no perceptible sentence accents, and his traces are remarkably similar in the three different conditions, especially 'Anders och Kamma skall till Sandvik', where even the durations measure up to the same value. In the lower part, the utterance from the context that invited initial sentence accent differs somewhat from the others: the final stress group has shrunk, which fits an auditory impression of a certain downgrading of its prominence (which did not put a perceived sentence accent on any of the preceding words). MD pronounced the topmost utterances with stressed 'kommer', and as noted earlier, all of his utterances sounded as if the second stress group was slightly more prominent than the surroundings, which may be attributed to its slightly higher position in the range.

Figures 12 and 13

Average fundamental frequency tracings (logarithmic display) by two Malmö speakers of three utterances, uttered in isolation and in different contexts. Utterances in isolation are drawn in full lines, utterances with invited final sentence accents in broken lines, initial sentence accents in dotted/broken lines, and utterances with invited medial sentence accents in dotted lines. Note though that very few sentence accents were actually perceived, see further the text. The word accents are identified in Arabic numerals above the stressed vowels in the sentences. See further the legend to figures 1-7. Note that HD produced 'Kamma kommer från Svaneke' with unstressed 'kommer'.

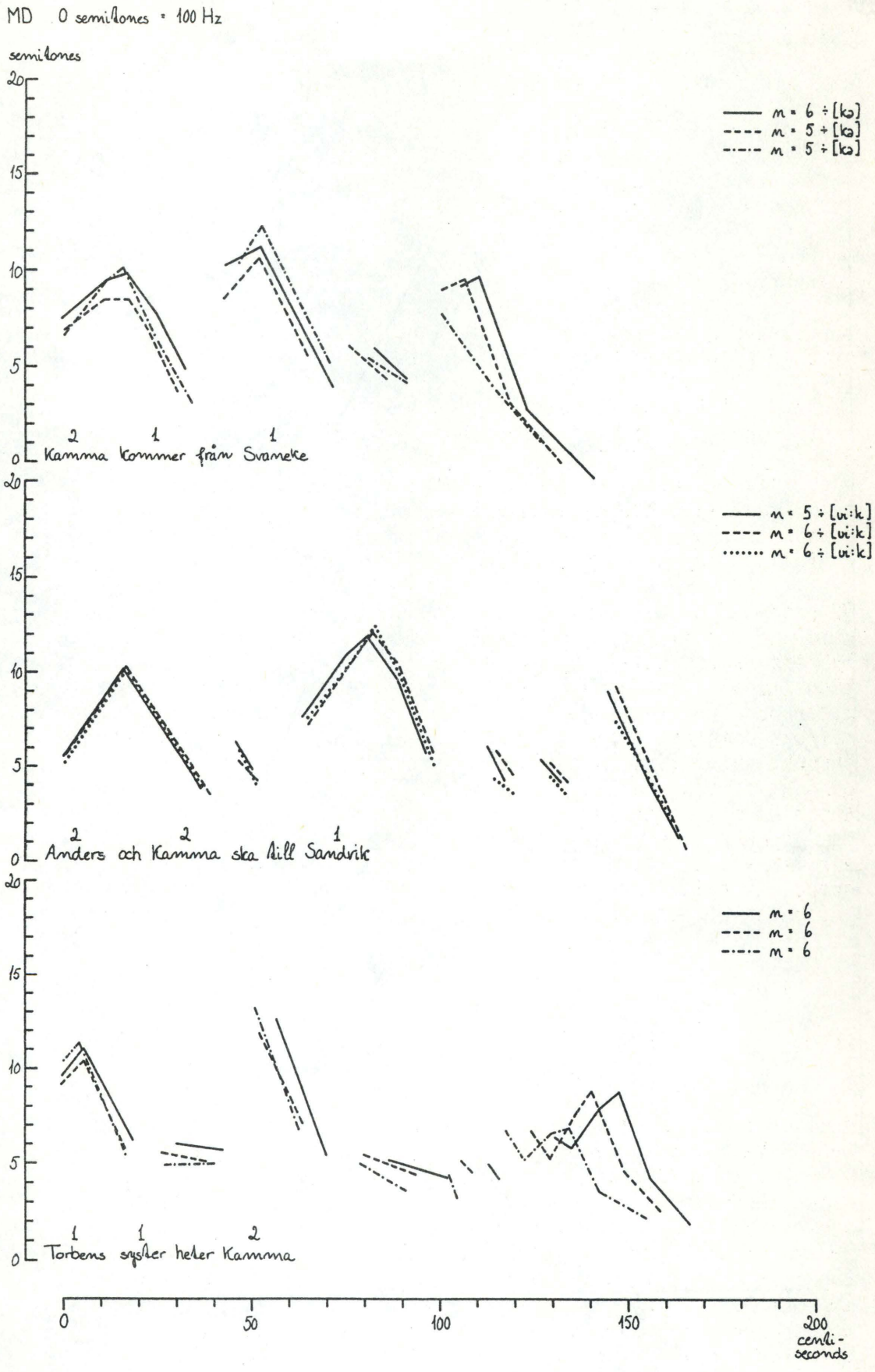

MD 0 semitones = 100 Hz
semitones
20
15
10
5
0
n = 6 ÷ [kɔ]
n = 5 ÷ [kɔ]
n = 5 ÷ [kɔ]
2 1 1
Kamma kommer från Svaneke
n = 5 ÷ [vi:k]
n = 6 ÷ [vi:k]
n = 6 ÷ [vi:k]
2 2 1
Anders och Kamma ska till Sandvik
n = 6
n = 6
n = 6
1 1 2
Torbens systrar heter Kamma
0
50
100
150
200
centi-seconds

Figure 12

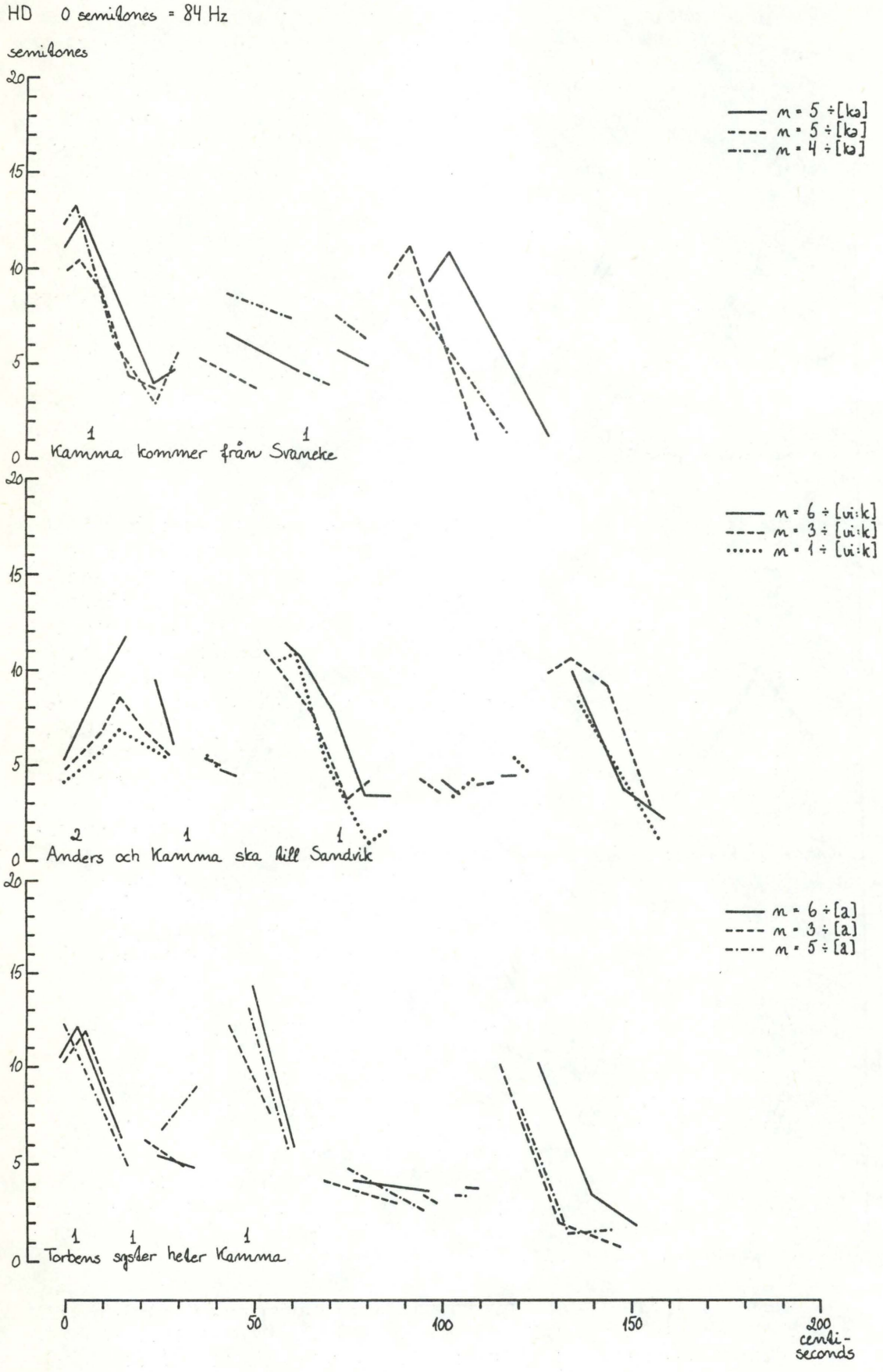

HD 0 semitones = 84 Hz
semitones
20
15
10
5
0
n = 5 ÷ [kə]
n = 5 ÷ [kə]
n = 4 ÷ [kə]
1 1
Kamma kommer från Svanekc
n = 6 ÷ [vi:k]
n = 3 ÷ [vi:k]
n = 1 ÷ [vi:k]
2 1 1
Anders och Kamma ska till Sandvik
n = 6 ÷ [a]
n = 3 ÷ [a]
n = 5 ÷ [a]
1 1 1
Torbens systrar heter Kamma
0
50
100
150
200
centi-
seconds

Figure 13

The second stress group here could be described as a "pivot" in Gårding's (1986) terminology, i.e. a point where the global trend changes direction (in casu: from rising to falling) or where the "grid" within which Fo moves up and down changes width . Gårding (1986) makes the location of the pivot syntactically determined, but that can hardly be the case here, since the NP/Predicate boundary is differently located in the topmost versus the two lower utterances.

HD produced some sentence accents initially and finally, respectively, in the topmost utterance and one medial and some final SAs in the middle one. In the lower part of the figure, the broken line is the utterance from the context which invited final sentence accent, but did not sound like it had any. The broken/dotted line is the utterance which could have had an initial SA, but did not. However, this utterance and the isolated one both sounded as if 'syster' was slightly more prominent than the surroundings, cf. the remarks about MD above.

The manifestation of the scattered sentence accents by HD is very different from the Stockholm data, and also rather at odds with what Bruce (1979), Bruce and Gårding (1978), and Gårding (1978) found, but quite in line with Touati (1987) who also used HD as (supplementary) speaker: final sentence accent does not increase the Fo range of the stress group, relative to the neutral edition, but it lowers/diminishes the first stress group pattern (figure 13, top and mid). Initial sentence accent (figure 13, top) has a slightly wider range, but the skip up to the post-tonic syllables ('kommer från') is much more conspicuous, together with the smaller movement in the final stress group. The medial sentence accent does have a wider Fo range, which is achieved by extending the fall which is what the literature prescribes. But it also shares the lowering/diminishing of the first stress group and the rise through the post-tonics with final and medial SA's, respectively. So the reinforcement of the word accent by superposition of an SA is not unambiguous, it seems, and SA has other effects, besides.

In other words, the two Malmö speakers differ from the two Stockholm speakers partly in their lack of any (syntactic/prosodic final - default) sentence accent in isolated utterances, and in their pronounced reluctance to express the theme/rheme structure of an utterance prosodically. Those few sentence accents actually present also get realized differently (less unambiguously). Nor does the realization of sentence accent resemble the Bornholm data, which in fact are much closer to the Stockholm data as far as realization goes (but not in the exceptionless application).

There is a further difference between Malmö and Bornholm in the more global trends: where the Bornholm speakers, in neutral and final SA utterances, produce a high and level contour, with a comparatively narrow range of Fo variation, preceding a sharp final fall, the Malmö speakers have a mildly

rising-falling global trend with approximately equal magnitude Fo variation in each stress group.

(d) Copenhagen

NRP (figure 14) shares with MD from Malmö the nearly complete identity between utterances from different conditions. The lack of any Fo/pitch prominence is evident, as is the distribution of a gradual, global, sentence intonation fall from the first through the last stressed vowel. The low+high-falling stress group pattern is also apparent. (The fact that 'Anders' exhibits a clean rise is due to the glottal attack at the onset: note that 'Kamma' and 'Torben' onset at around 10 semitones, and the low turning point lies around 8 semitones. 'Anders' onsets much lower, but passes through 8 semitones at the same point in time where the low turning point in 'Kamma' and 'Torben' is located.)

The auditory impression of focalization of initial and medial items, though not of any sentence accent in NT's utterances, is corroborated by figure 15, where a certain shrinking of the succeeding stress group after an initial focus and of the stress group preceding a medial one, respectively, can be observed. The item which gave the auditory impression of being focalized has not an inkling of wider range, quicker movement or longer duration, compared with those utterances where no focus was perceived, and I do think it is justified to conceive of these utterances as being without sentence accent, though not without a relative (down-)grading of the prominence of the (non-focal) stressed syllables. The realization of initial and medial focalization (note that NT did not produce any final foci) is reminiscent of - though not identical with - the way emphasis for contrast is realized, cf. figure 16. Emphasis leads to a deletion of surrounding stress group patterns (i.e. on both sides) as well as to a certain increase in the Fo level and range of the emphasized item.

In conclusion, the lack of any sentence accent in Copenhagen Danish, as it is understood in, e.g., Standard Swedish, is uncontestable. Its non-compulsory status in Malmö has been corroborated by the present data, as has its presence as an option for Bornholm speakers, and its (near-)universality in Stockholm. This very different way to deal with utterance prosody may reflect differences elsewhere in the spoken language.

Figures 14 and 15

Average fundamental frequency tracings by two Copenhagen speakers of three utterances, uttered in isolation and in different contexts. See further the legend to figures 12 and 13 and figures 1-7.

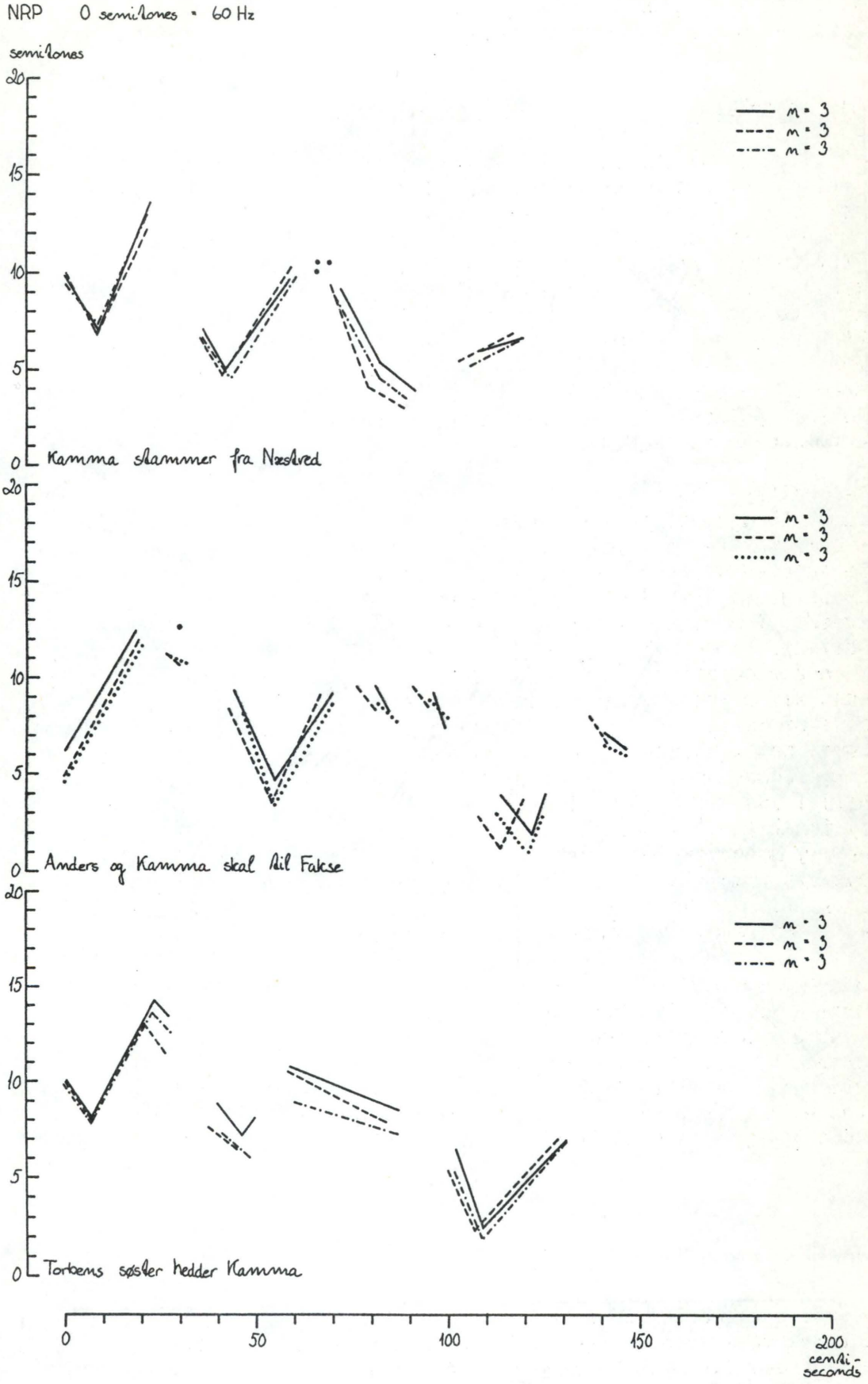

NRP 0 semitones = 60 Hz
semitones
20
15
10
5
0
n = 3
n = 3
n = 3
Kamma skammer fra Nexstved
n = 3
n = 3
n = 3
Anders og Kamma skal til Falcse
n = 3
n = 3
n = 3
Torbens søsker hedder Kamma
0
50
100
150
200
centi-seconds

Figure 14

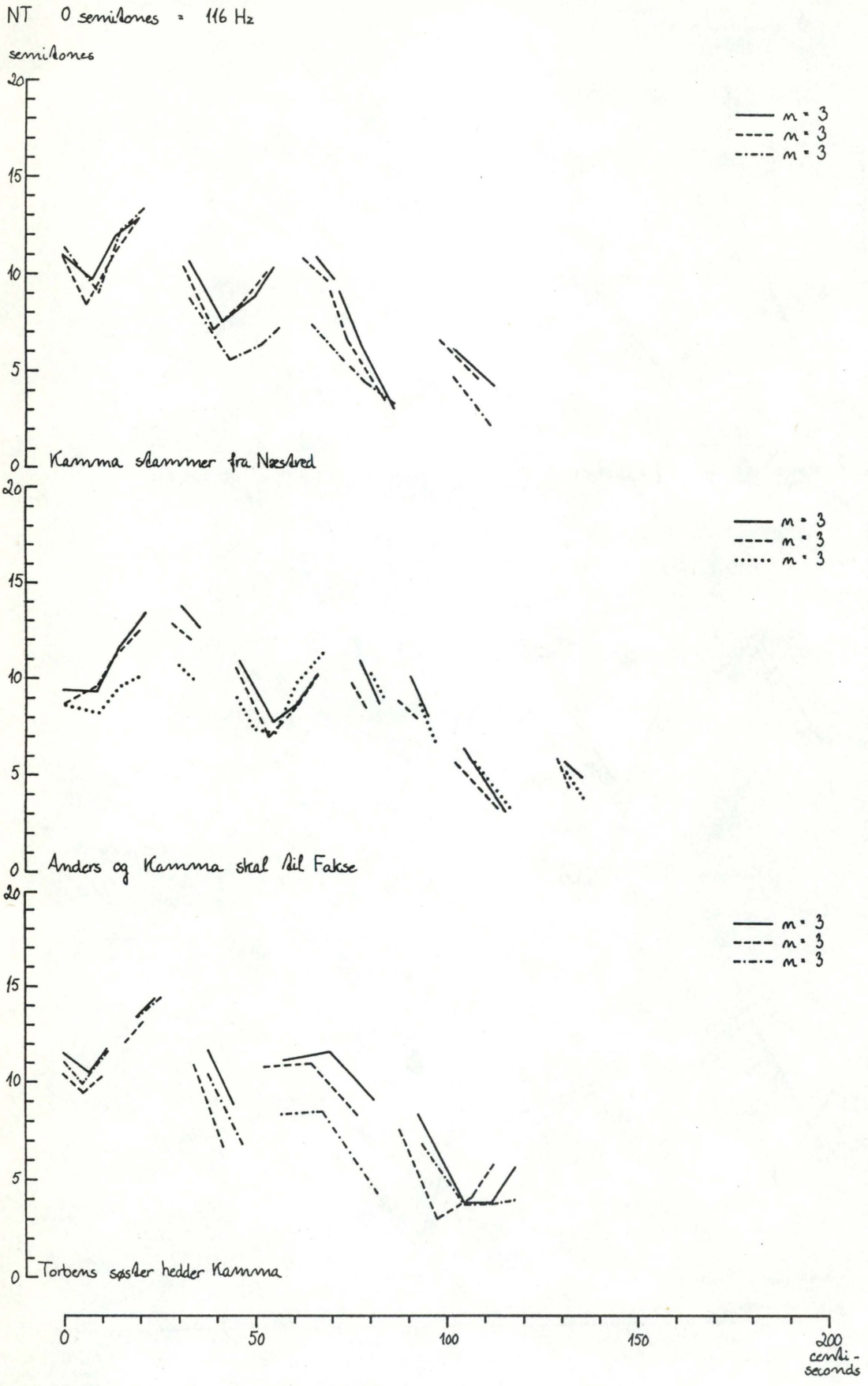

NT 0 semitones = 116 Hz
semitones
20
15
10
5
0
m = 3
m = 3
m = 3
Kamma slammer fra Næsbred
m = 3
m = 3
m = 3
Anders og Kamma skal til Fakse
m = 3
m = 3
m = 3
Torbens søsker hedder Kamma
0
50
100
150
200
centi-seconds

Figure 15

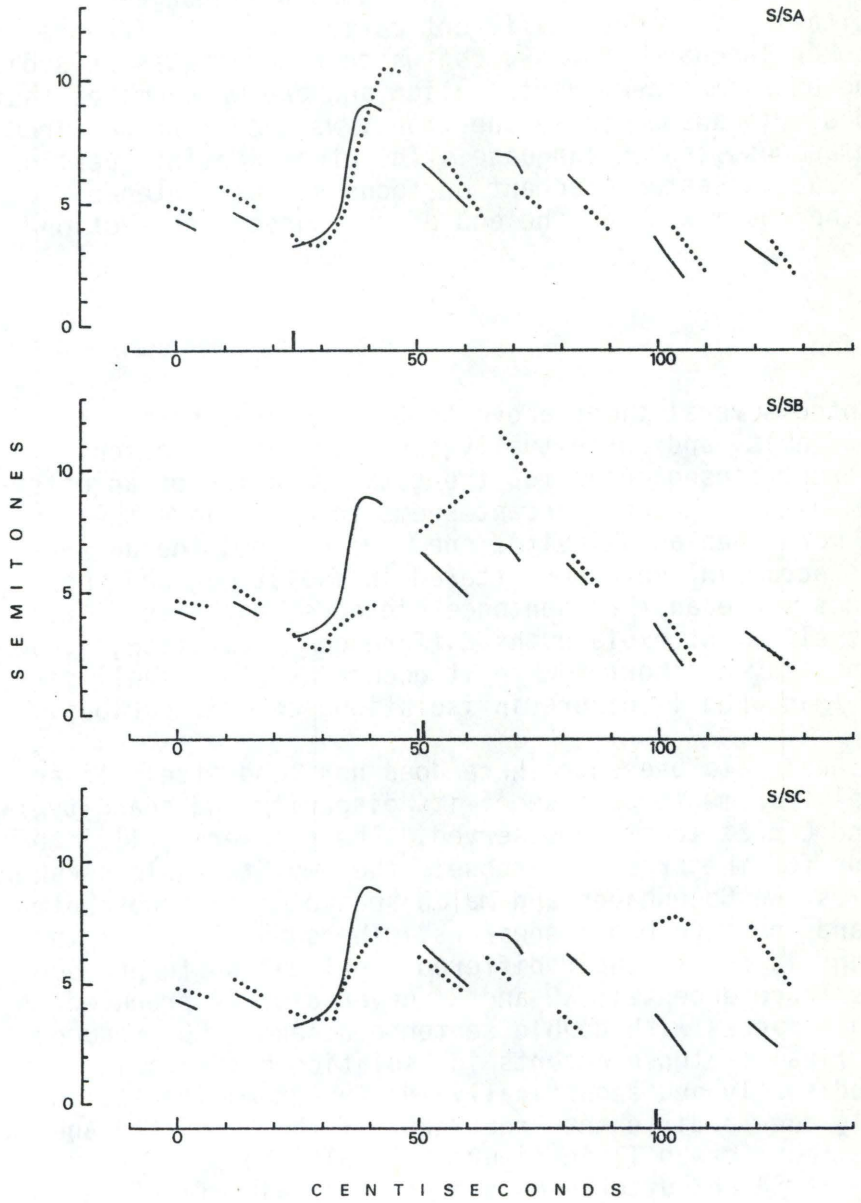


Figure 16

Fundamental frequency tracings (mean of means over six readings by each of three subjects and ten readings by one subject) of 'Der går mange busser fra Tiflis.' [dɑ gɒ ˈmɑŋ ˈbusʌ fʁɑ ˈdˢiflis]*: prosodically neutral (S - full lines) and with emphasis for contrast (dotted lines) on 'mange' (SA - top), on 'busser' (SB - mid), and on 'Tiflis' (SC - bottom). Zero on the logarithmic frequency scale corresponds to 100 Hz. The tracings have been lined up according to the beginning of the emphasized vowel (heavy stroke on the time scale). Reproduced from Thorsen, 1980b.)*

Does a language/dialect which has neither a default (-pitch prominent) sentence accent nor a rhematically conditioned one (like Standard Danish) have a different spoken language grammar from a language which has both default and rhematic sentence accents (like Stockholm Swedish)? And does a language/dialect with facultative SA's have different options or more freedom in the spoken language grammar, one which necessitates prosodic signalling of rheme/theme distribution and one which makes that superfluous? To answer these questions, we need more research into spontaneous, spoken language. The other pending question, that of focus as sentence accent or focus versus sentence accent will be dealt with at the end of the succeeding section on duration.

3. Duration

I have hinted several times above that pitch prominent, uninvited (default) and contextually invited sentence accents have different consequences for the total duration of an utterance: an invited sentence accent seems to abbreviate the utterance more than an uninvited one. Of course, the uninvited SA's occur in sentences uttered in isolation, and the invited ones where another sentence precedes, and this difference in itself might explain the difference in duration, i.e. an utterance may be shorter when it occurs as (the final) part of a text than when it occurs in isolation, ceteris paribus.

The durational data presented here does not lend itself to any statistical treatment, because of its disparity and scarcity, but a trend can at least be observed. The speakers fall into four groups for the present purpose: the two Stockholm speakers, the two plus two Copenhagen and Malmö speakers, four Bornholm speakers and three Bornholm speakers. The subdivision of the Bornholmians is due to their different inclination to produce default sentence accents: KP and RK never did; CA produced isolated utterances with double sentence accents; HC produced plenty of final sentence accents in isolation but each item with a (auditorily and acoustically) different manifestation (apparently due to different "readings" of the same utterance). From those four (group II in figure 17) only isolated utterances without SA and utterances from context with final SA are included in the calculations. HP, JT, and IB (group I) are ideal from the present point of view: they produced isolated utterances with and without sentence accent; HP and JT also produced utterances from context with and without SA. To make the durational data comparable across speakers, a normalization is required. The isolated, no SA edition of each sentence is set at 100, and the others adjusted proportionately. The Stockholm speakers (group III) had no isolated utterances without SA (with the exception of two items by BjH), so when the average duration for isolated utterances with SA by group I had been found (96.4 re 100 cs), that was the value assigned to the same utterances by the Stockholmians, and their utterances with SA from context was calculated to this proportion.

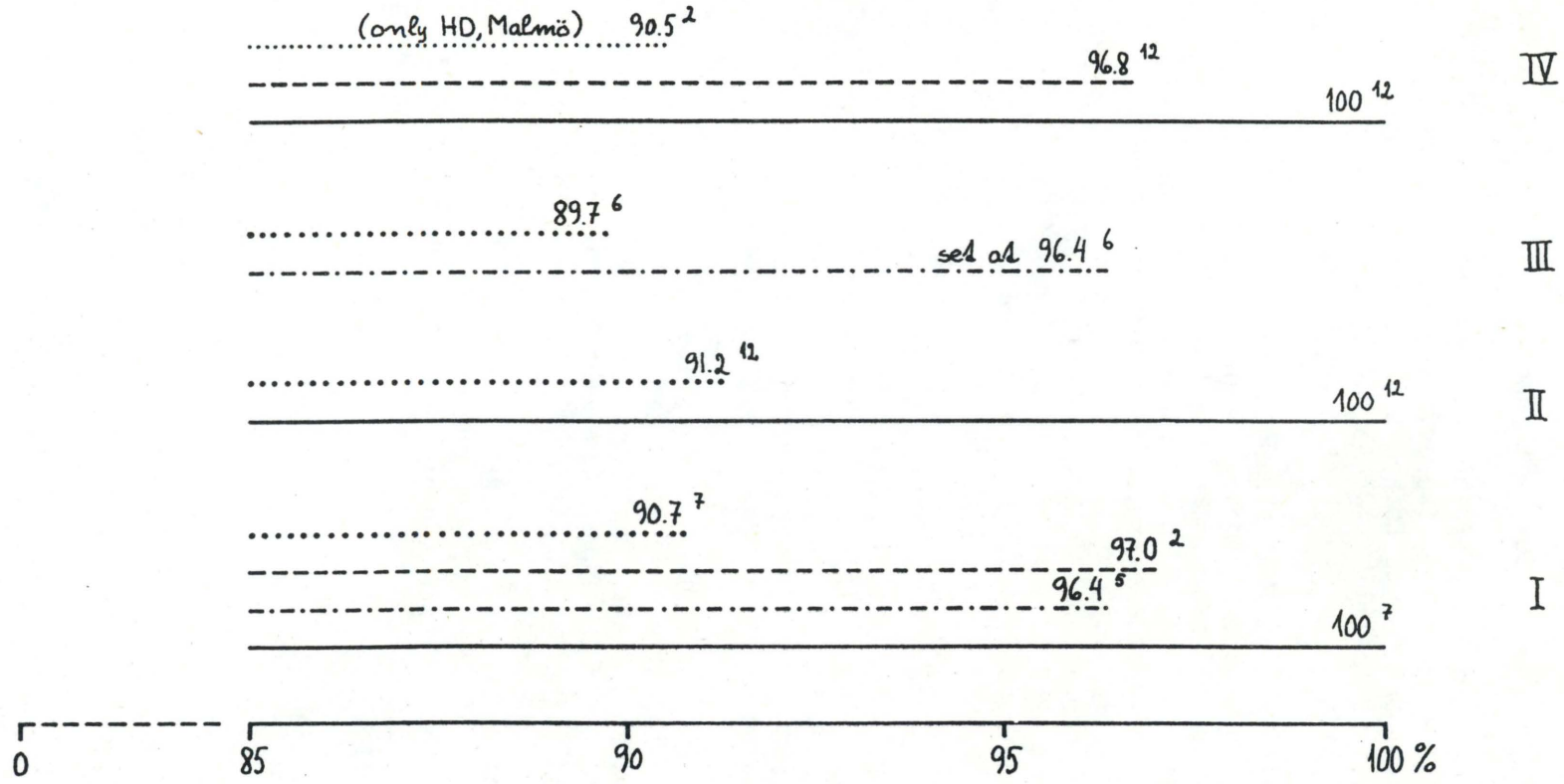


Figure 17

Normalized duration of utterances produced in isolation without any perceived sentence accent (full line = 100%), utterances produced in isolation with a perceived (final) sentence accent (dotted/broken line), utterances produced in context without a perceived sentence accent (broken line), and utterances produced in context with a perceived (final) sentence accent (dotted line). Four groups of speakers: I comprises three Bornholm speakers, II four Bornholm speakers, III two Stockholm speakers, and IV two Malmö plus two Copenhagen speakers. See further the text.

Figure 17 presents the results for the four groups of speakers. The number of sentences behind each average is given in raised numerals. For groups II-IV, there is generally 5 or 6 items behind the average for each sentence, but that cannot be so for group I, where the sum of items with and without SA for each sentence does not exceed 6. Granted the reservations which are due to the complexity of the data, certain interesting observations can be made: abbreviation due to context in utterances without SA amounts to about 3% (see group I and IV, broken lines versus full lines). Abbreviation due to context in utterances with SA (dotted/broken versus dotted lines) amounts to 5.9% (group I: 96.4-90.7 as a percentage of 96.4) and 7.0% (group III: 96.4-89.7 as a percentage of 96.4), respectively, averaging at 6.5%. Adding a sentence accent to an isolated utterance will abbreviate it by 3.6% (full versus dotted/broken lines, group I). In other words: take an isolated utterance and give it a default final sentence accent, and it will come down to 96.4% of its original duration. Take the same utterance and put it into a context which invites a final accent, and it will come down to around 90%. Only about 3% of that abbreviation can be ascribed to its being in context, as such. The remaining 7% is due to the invited sentence accent, which is more than the 3.6% that a default accent will yield. - So there is some support to be had for a statement to the effect that invited and uninvited final sentence accents have different effects on an utterance: the invited SA reduces the utterance more, both in terms of duration and in terms of Fo (I am referring to the lowering/shrinking of preceding stress groups with some speakers).

The abbreviation due to sentence accent is approximately evenly distributed over the utterance (this can be seen from the Fo tracings in figures 1-7 and 10-11), but not quite, as witnessed by measurements of the duration of the part of the utterance preceding the final stress group (A) and of the total duration. The relevant data come from the three Bornholm and the two Stockholm speakers (groups I and III). The smallest value in each set of utterances (each sentence) is A in the utterance with invited sentence accent. When that is set at 100 and the other measures adjusted proportionately, averaging over speakers is possible. Since the final word undergoes 'final lengthening' in Stockholm (see further below) but not in Bornholm, the two groups must be treated separately. Figure 18 shows the results. - The utterances from context with invited sentence accent are shorter than the isolated ones with sentence accent, which in their turn are shorter than isolated utterances without sentence accent (Bornholm), cf. above. The shortening of the final item itself is modest, cf. the rightmost parts of the figure. The major part of the shortening is carried by the preceding part of the utterance, which accordingly takes up a smaller proportion of the whole utterance preceding an invited versus an uninvited SA, as indicated by the percentages written in the figure. Those percentages are relatively smaller in Stockholm than in Bornholm, due to the lengthening of the final word.

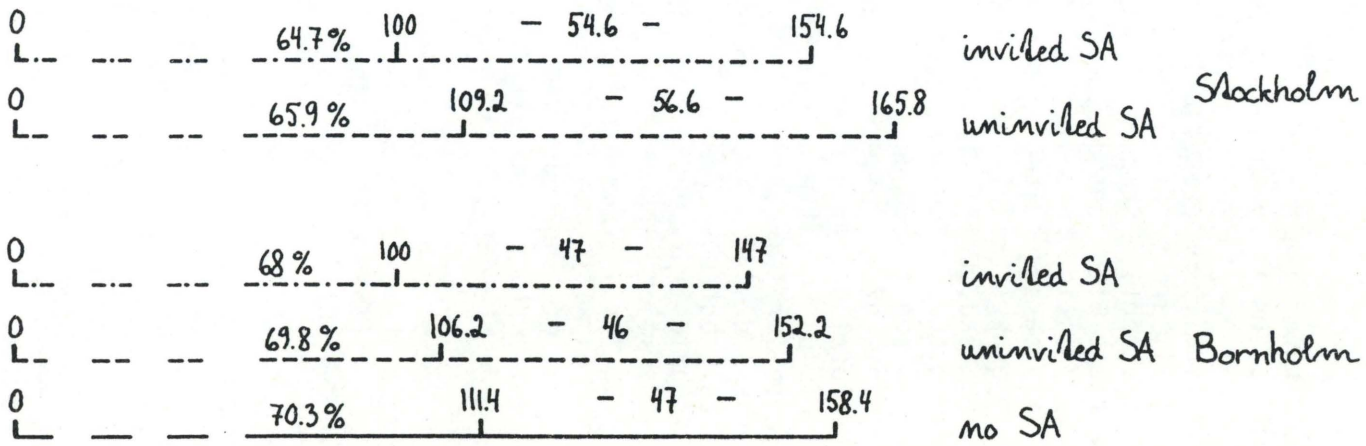


Figure 18

Normalized durations of utterances by two Stockholm speakers and three Bornholm speakers, with and without final sentence accents, as indicated to the right of the figure. A is the part of the utterance preceding the final stress group. See further the text.

It is highly desirable that these observations be confirmed by further data, but in their absence I will stick my neck out some and suggest that default sentence accents and accents for focus or rheme signalling are two different phenomena, both with regard to their function and their phonetic form.

4. Conclusion

I would suggest that Stockholm Swedish has an obligatory default sentence accent, whose application is syntactically and/or prosodically determined (in a loose term it is phrase-final, whether the phrase be syntactically or prosodically defined. Isolated utterances occasionally are supplied with both an initial and a final sentence accent). Stockholm Swedish also generally signals focus or rheme with prosodic means, with a focal accent, which in final position resembles the default sentence accent, though it may be associated with a somewhat larger Fo excursion, and, more particularly, it shortens the utterance more and it may entail a certain lowering/diminishing of preceding Fo patterns without, however, jeopardizing the differentiation of the two tonal word accents. I would like to inquire whether the loss of the rise, found elsewhere in Accent II words, in post-focal position could be interpreted as a loss of an autonomous Fo pattern, which in its turn might be ascribed to a de-stressing, i.e. whether the main stress of lexically stressed words is not down-graded to secondary stress in post-focal, but not pre-focal position? The secondary stress status would imply that other characteristics of main stress, e.g. duration, are retained, as also implied by Bruce's (1981) results, a state of affairs analoque to the difference between the phonetic manifestation of main and secondary stress in Danish, cf. Thorsen (1980b). - I would also like to call attention to the one utterance (three items) by ER, where I had no doubt that its second stressed word was in focus, but which lacked the ordinary acoustic signs of a sentence accent, except for the reduction of the tonal pattern on the following stress group. Does this mean that focus can be brought about (in Stockholm) through stress reduction (of succeeding words) only?

The situation in Bornholm resembles Stockholm to a certain extent. But the default, final sentence accent is not obligatory (and some speakers do not use it at all). Furthermore, utterances in context do not invariably signal a focus or rheme with prosodic means (spliced out they sound like isolated utterances), but when they do, the focal accent resembles the Stockholm way to render it (increased Fo range on the focalized item, lack of autonomous Fo patterns on succeeding ones).

The Malmö speakers are, curiously enough, more different from Stockholm than the Bornholm speakers are. They lack a default accent, and the focal accent is not obligatory. When and where it is employed (which was only in some utterances by one speaker), its prosodic expression is less conspicuous as an increased Fo movement on the stressed syllable, but the post-

tonics may perform a more ample movement (they rise rather than stay low and level after the fall of Accent I - I have no data on focalized Accent II words from Malmö), and the preceding stress group pattern(s) shrink(s). Succeeding patterns do not seem to suffer the same obliteration as is characteristic of the focal accent in Stockholm. In other words, the focal accent is much less explicitly and generously signalled in Malmö than in Stockholm and Bornholm.

Copenhagen Danish lacks a default sentence accent, and focus rarely gets expressed prosodically (especially not in final position, which is interestin since final position attracts more focal accents than medial position, when it is facultative (Bornholm, Malmö)). When such is the case, the sole means seems to be a downgrading of surrounding stresses, though the low+high pattern is retained, but no amplification of the focalized item. (This is the difference from emphasis for contrast, where the emphasized item generally does have a more ample movement, ahd where surrounding stress group patterns are deleted.)

To sum up: I suggest that the non-provoked, syntactically and/or prosodically determined, extra Fo/pitch prominence associated with final (and occasionally also initial) stressed words in Stockholm and Bornholm be termed default sentence accent, which may be obligatory (as in Stockholm) or facultative (as in Bornholm). As a phenomenon apart, there exists a focal accent whose prosodic manifestation is somewhat different from - stronger than - the default sentence accent. It may be very general (as in Stockholm), less general but frequent (as in Bornholm), comparatively rare (as in Malmö), and non-existent or taking a very different prosodic shape (as in Copenhagen). - It is tempting to speculate, as I noted above, that with such a difference in the prosodic systems of otherwise very closely related languages follows a difference in the spoken language grammar (as opposed to the written language). Here is evidently a point for further investigations.

B. SENTENCE INTONATION

1. The Kamma utterances

The fairly short, terminal declarative utterances described above group themselves in three major types, according to the regional language: Copenhagen speakers signal the function of the utterance globally, i.e. evenly across the stressed syllables, with no extra movement finally. The final stress group is not qualitatively different from preceding ones: its post-tonic syllable rises from the low fall of the stressed one, although this rise is of a somewhat smaller extent than in preceding stress groups, which creates the impression of a wedge-shaped "grid" within which Fo rises and falls. This is entirely in accordance with previous results on Standard Danish terminal declarative sentence intonation, cf. Thorsen

(1978, 1980c, 1983, 1985, 1986a, 1986b). The Bornholm and Stockholm Swedish speakers signal the declarative function mainly through the fall in the final stress group (in utterances with no sentence accent as well as with final default or focal accent). This fall is more extensive in time when the focal accent is moved left in the utterance, i.e. it extends from the peak Fo value of the focalized item to the end of the utterance. Stockholm and Bornholm speakers differ in the precise manner in which they perform the fall in a final (accented) stress group. With the Bornholm speakers it is contained within the stressed (and post-tonic) syllable(s) which has the effect of reversing the otherwise prevailing low (falling)-high (rising) stress group pattern into a high-low (high-falling) one. (Exceptions are KP and IB, final 'Svaneke', where the terminal fall is added to the fall-rise pattern.) The Stockholm speakers tag the fall onto the same pattern which characterizes the stress group in other positions (compare initial accented 'Kamma' and final accented 'Kamma' in figures 10 and 11, top and bottom). The stress group is considerably lengthened finally (which is not the case in Bornholm, see further below). (What is cause and what is effect is of no concern here, i.e. whether the lengthening is a passive consequence of the extensive, complex Fo movement, or whether it is an autonomous boundary feature to which Fo is adjusted. The reader is referred to Lyberg (1979, 1981) and Bannert (1982) for opposing views on this issue.) Bruce (1977) showed that when word accent, sentence accent and terminal juncture commands pile up on one utterance final (Accent I) syllable, the sequence of canonical rise-fall +rise+fall is adjusted (compressed) to a rise+high plateau+ delayed fall. When a (disyllabic) Accent II word is utterance final and accented, the fall-rise+rise+fall results in an undershooting of the sentence accent target maximum and a delayed fall. I have no examples of the former case, but the final accented Accent II words ('Kamma' and 'Svaneke' (ER only)) conform well with Bruce's statements. In other words, the terminal junctural fall is added to a pattern which may undergo a certain compression, while at the same time the whole sequence is lengthened, relative to other positions in the utterance.

The Malmö speakers behave differently again. The global trend is mildly rising-falling, with the second stress group as turning-point or pivot. It is not apparent that those final falls that occur are systematically more extensive than elsewhere in the utterance, ceteris paribus, cf. figures 12 and 13. (This is not due to the rarity of (final) sentence or focal accents, per se, because the Bornholm speakers' local final falls occurred also when no sentence accent was perceived.)

2. The long declarative and the questions

The long declarative utterance, and the dialogue with a wh-question and a one-word echo-question should illustrate further similarities/differences between the four regions.

(a) The long declarative (figures 19-31):

These utterances confirm, to a large extent, what has been said already. But there are some modifications to be made. Note, first, that Stockholm speaker ER phrased and paused after the noun phrase and before the time complement. She is not considered any further at this point. Other speakers also bear witness to moderate resettings of the long intonation contour, see further below.

NT clearly belongs with the Bornholm speakers here, as far as the distribution of the fall is concerned. In a previous investigation of long sentences (Thorsen 1983) I also deviated from the pattern set by other Copenhagen speakers, which is probably testimony to too much familiarity with the material and lack of naïveté as to its purpose, rather than a Copenhagen feature. Thus, two groups are formed, one composed of the seven Bornholm speakers, BjH (Stockholm) and NT (Copenhagen), and one of MD, HD (Malmö) and NRP (Copenhagen). There are differences within the group of Bornholm speakers as to how stress group patterns are shaped. They will be mentioned briefly below in this section and again in section III.C, but they are of no concern for the matter at issue here.

(i) Sentence accents. Before I proceed, I should note that I have found (by listening) considerably fewer instances of (final) default sentence accents (with the Bornholm and Stockholm speakers). One would expect them with ER, BjH, HP, HC, IB, JT and maybe CA, who produced double accents in isolated Kamma-utterances. ER did not produce any sentence accents in any of the three phrases, cf. figure 27: compare phrase-final 'Torsson, Snogebäck' with final 'Svaneke, Kamma' (Accent II) in figure 11 and compare final 'tisdag' with final 'Sandvik' (Accent I). The present examples compare much better with final, post-focal words in the Kamma-utterances, although I perceived no accents earlier in the phrases, either. BjH produced a perceptible prominence on final 'tisdag' which is backed up by the resemblance to final, accented 'Sandvik' in figure 10, i.e. the Accent I rise is located high in the range, relative to the preceding contour, and the fall to the post-tonic is both deep and steep. Among the Bornholm speakers HP is the only one who performed an unambiguous final accent: the last stress group covers a wide range, it begins high up, relative to the preceding contour (which cannot be said for any of the other speakers), and it also compares well with final accents in the isolated Kamma utterances (figure 1), although here it does not lead to a change in the preceding stress group pattern (no twisting down of its post-tonics).

The scarcity of default sentence accents in these utterances could be due to the nature of the sentences and the reading task, combined. In other words, I am suggesting that default accents are more likely to occur when the speaker is not required to pay as much attention to the "on-line" production of an utterance as is the case here: the sentences are long, and every lexical word is 'new' to the speaker, which is not an entirely unlikely reason for blocking an otherwise normal (obligatory or facultative) interplay between syntax and prosody.

The two Malmö speakers do not repeat the symmetrically rising-falling overall contour from the short Kamma-utterances. The higher fall on the second stressed syllable might be said to constitute a "pivot", however, as it did in the shorter utterances as well, though it is not very sharp. The ensemble of unstressed syllables perform a gently sloping downward course from beginning to end, a lower line which functions as point of departure or arrival for the falling (Accent I) or rising (Accent II) movements of the stressed syllables. (This is contrary to Touati's (1987) account, where the maxima in the tracings are seen as the stable points, from which falls of varying depth set off, according to their degree of prominence.) In much the same way, the low turning points in the stressed syllables of NRP step down gradually from left to right in figure 29, though a slight resetting seems to occur between the third and fourth stress group.

(ii) Local and global falls. In order to quantify the observation of local versus global terminal falls, I have measured the highest and the lowest Fo point occurring during the first six stress groups, and likewise the highest and lowest Fo in the final one. The results are given in figure 32, where the two speakers that had a final sentence accent (KP and BjH) are separated out (group I) from the rest of the "local" speakers (group II). Groups I and II are conspicuous by the fact that the lowest Fo in the final stress group (broken lines) is about 5 semitones lower than the lowest Fo value in the preceding part of the utterance (full lines), whereas with group III, the final low appears slightly higher in the comparison.

Figures 19-31

Average fundamental frequency tracings (logarithmic display) of a long terminal declarative utterance by seven Bornholm speakers, two Stockholm speakers, two Copenhagen speakers, and two Malmö speakers. Bornholm and Copenhagen speakers recorded the sentence indicated in figure 19, except that the Copenhageners went from 'Fuglebjerg' to 'Sorø'; the Stockholm and Malmö speakers recorded the sentence indicated in figure 26. The stressed syllables are drawn in thicker lines than the unstressed ones. The number of items is given in the upper right of each figure. Zero on the frequency scale corresponds to the same value as indicated in figures 1-7 and 10-15. Note that the time scale is compressed compared with previous figures. Note that the post-tonics are represented in continuous lines with Bornholm and Copenhagen speakers.

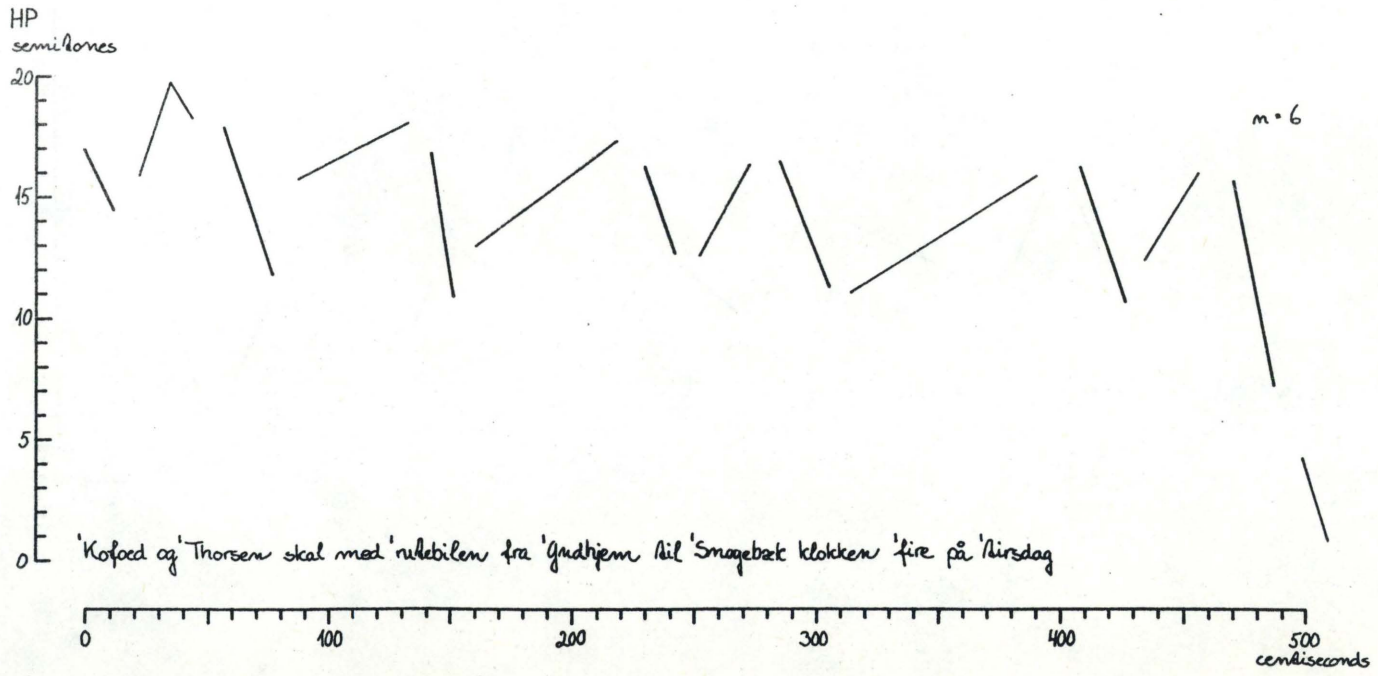

HP
semitones
20
15
10
5
0
m•6
'Kofoed og 'Thorsen skal med 'rutebilen fra 'Gudhjem til 'Snogebæk klokken 'fire på 'tirsdag
0
100
200
300
400
500
centiseconds

Figure 19

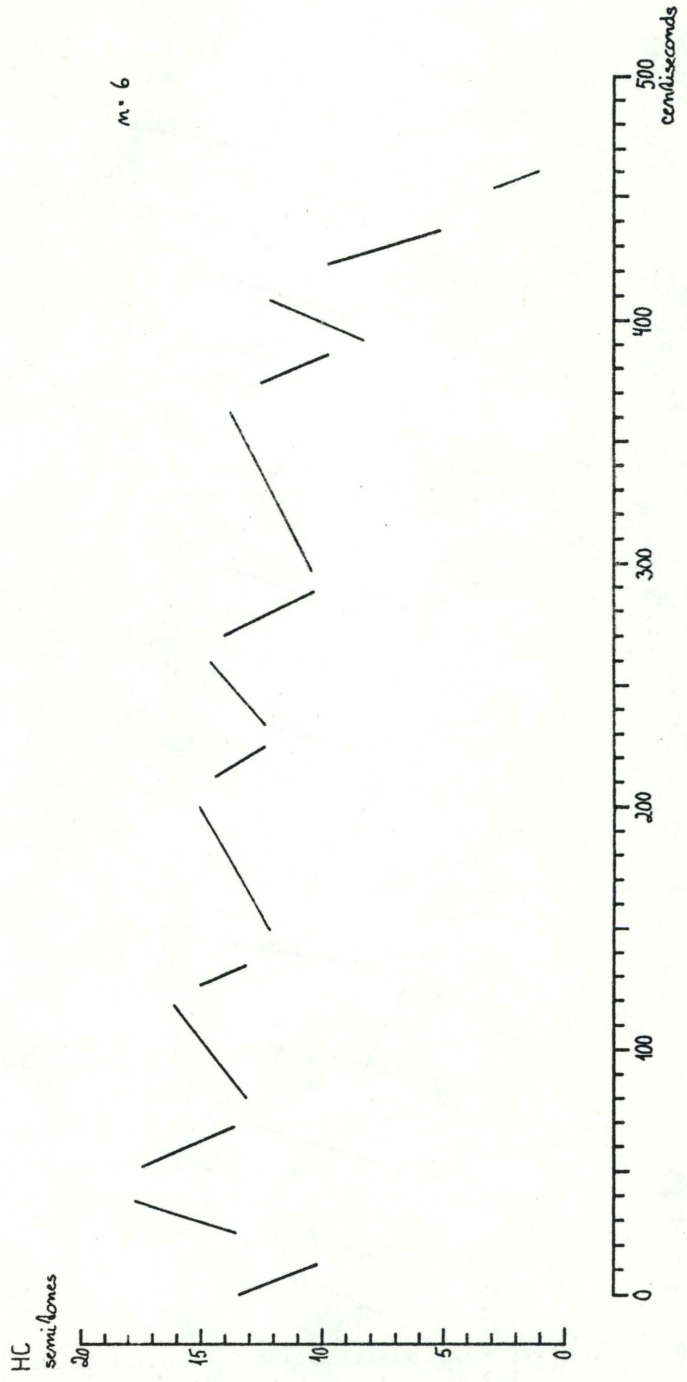


Figure 20

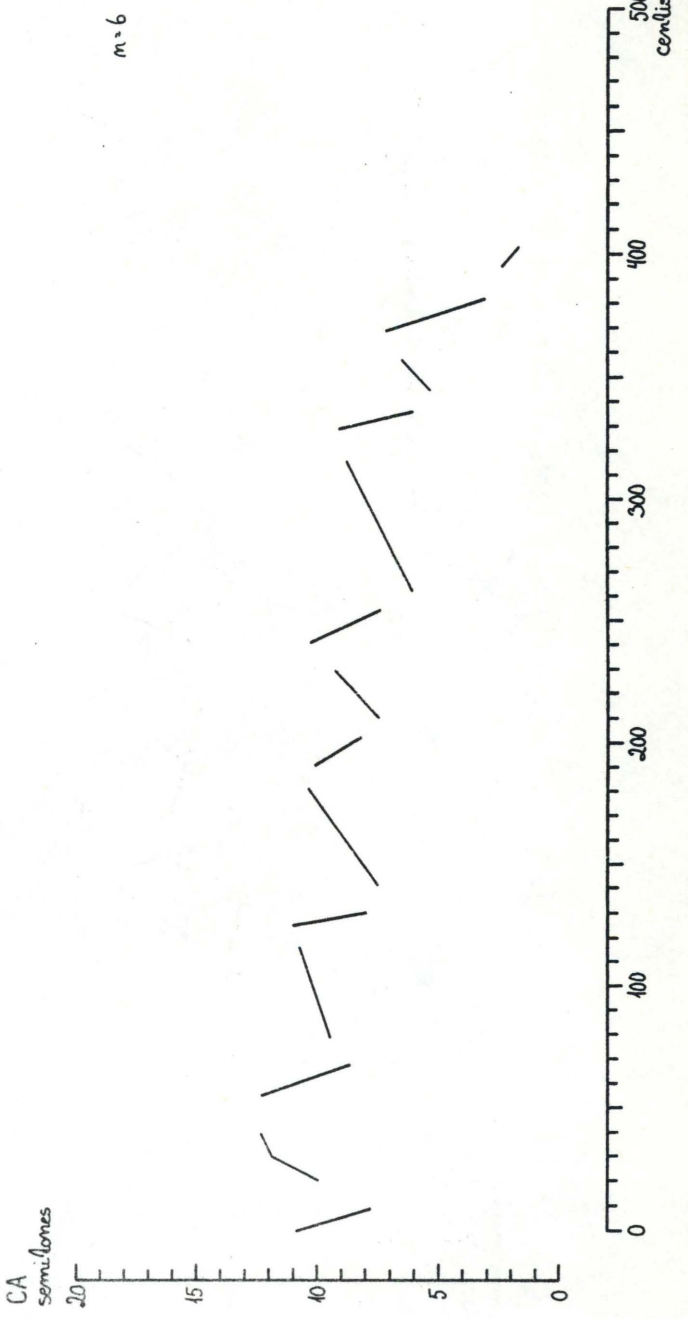


Figure 21

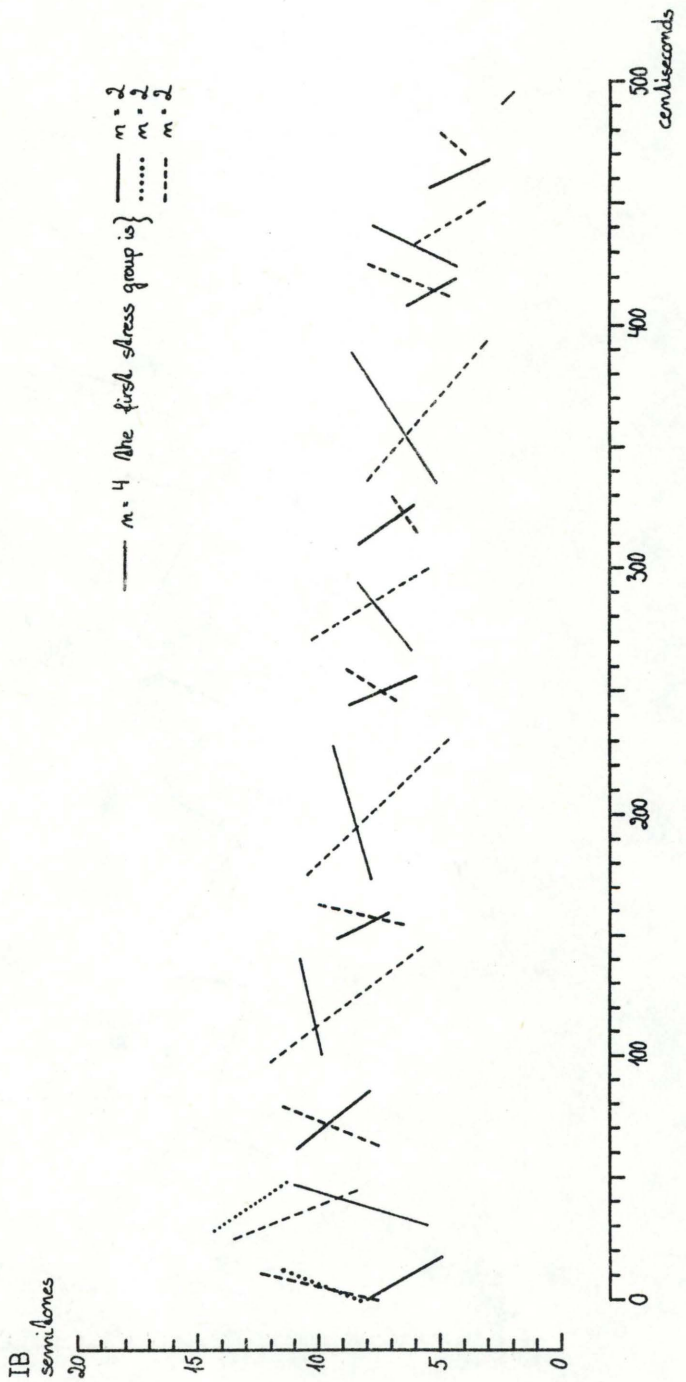

IB
semitones
20
15
10
5
0
0
100
200
300
400
500
centiseconds
— n = 4 (the first stress group is)
..... n = 3
---- n = 2

Figure 22

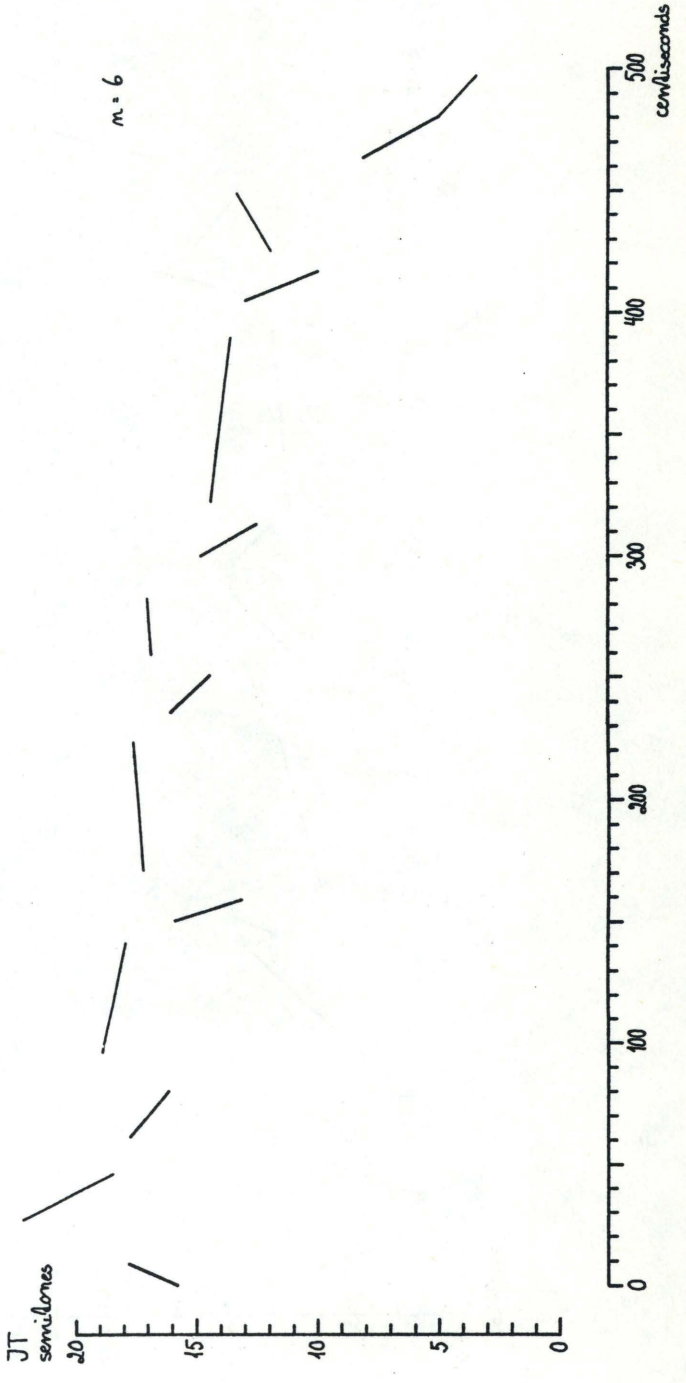


Figure 23

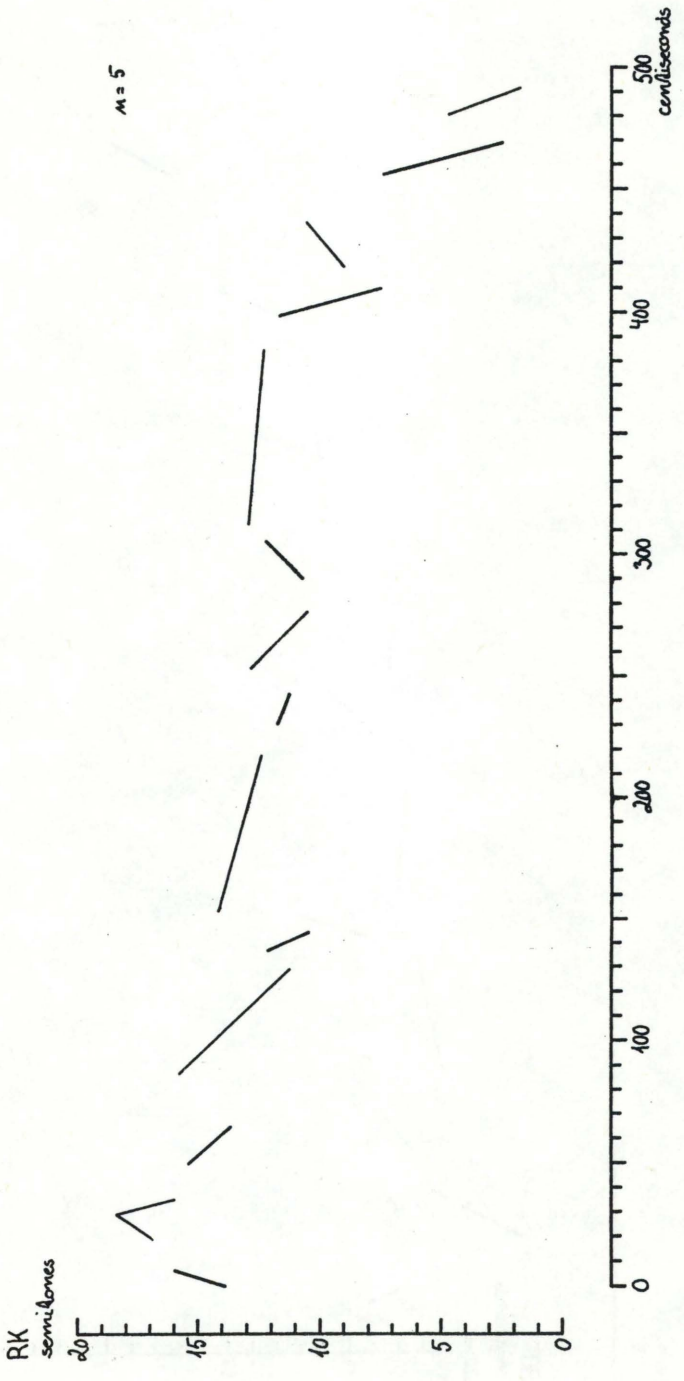


Figure 24

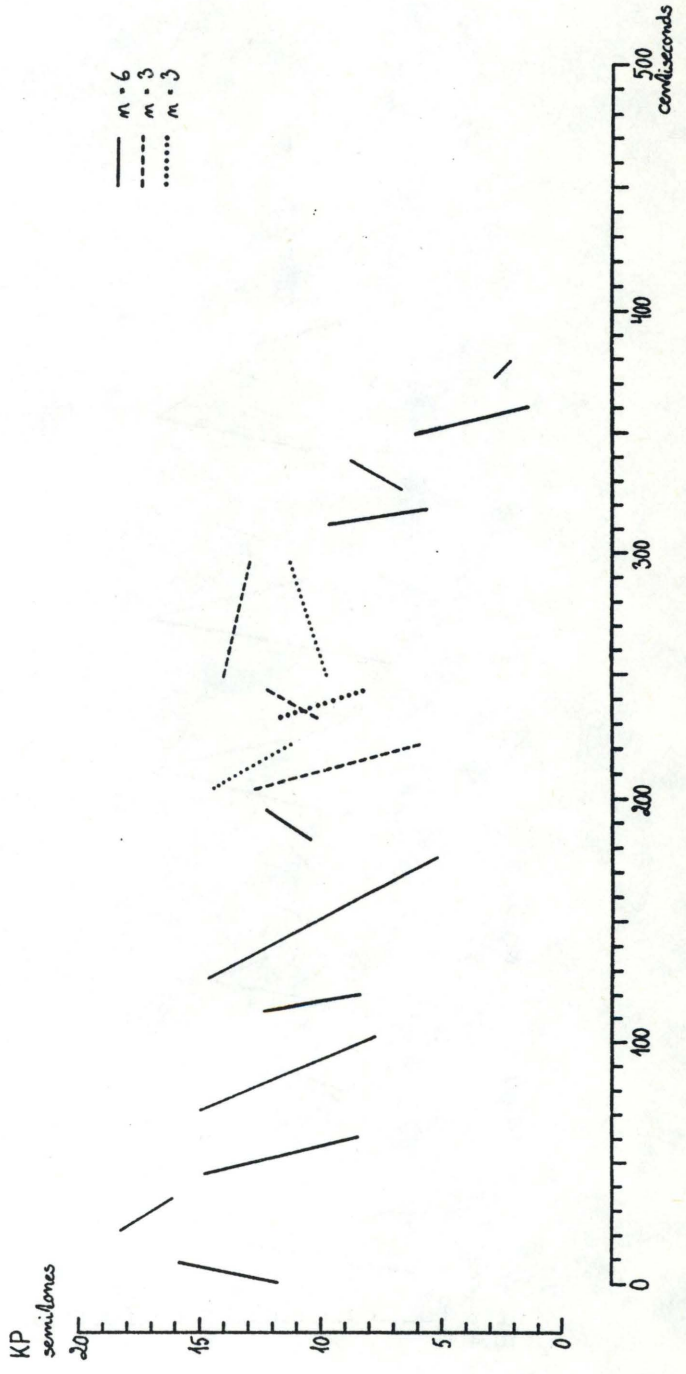

m-6
m-3
m-3
KP
semitones
20
15
10
5
0
0
100
200
300
400
500
centiseconds

Figure 25

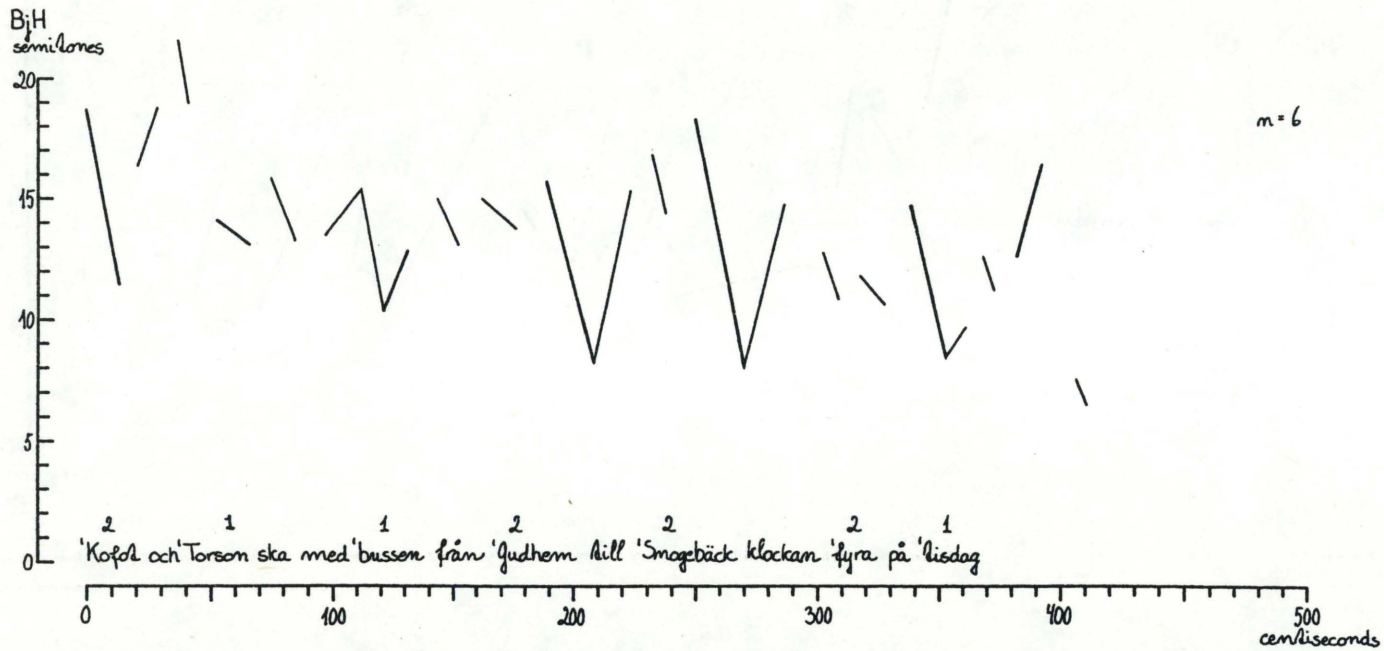

BjH
semitones
20
15
10
5
0
m = 6
2 1 1 2 2 2 1
'Kofoł och 'Torson ska med 'bussen från 'Gudhem till 'Snogebäck klockan 'fyra på 'lisdag
0
100
200
300
400
500
centiseconds

Figure 26

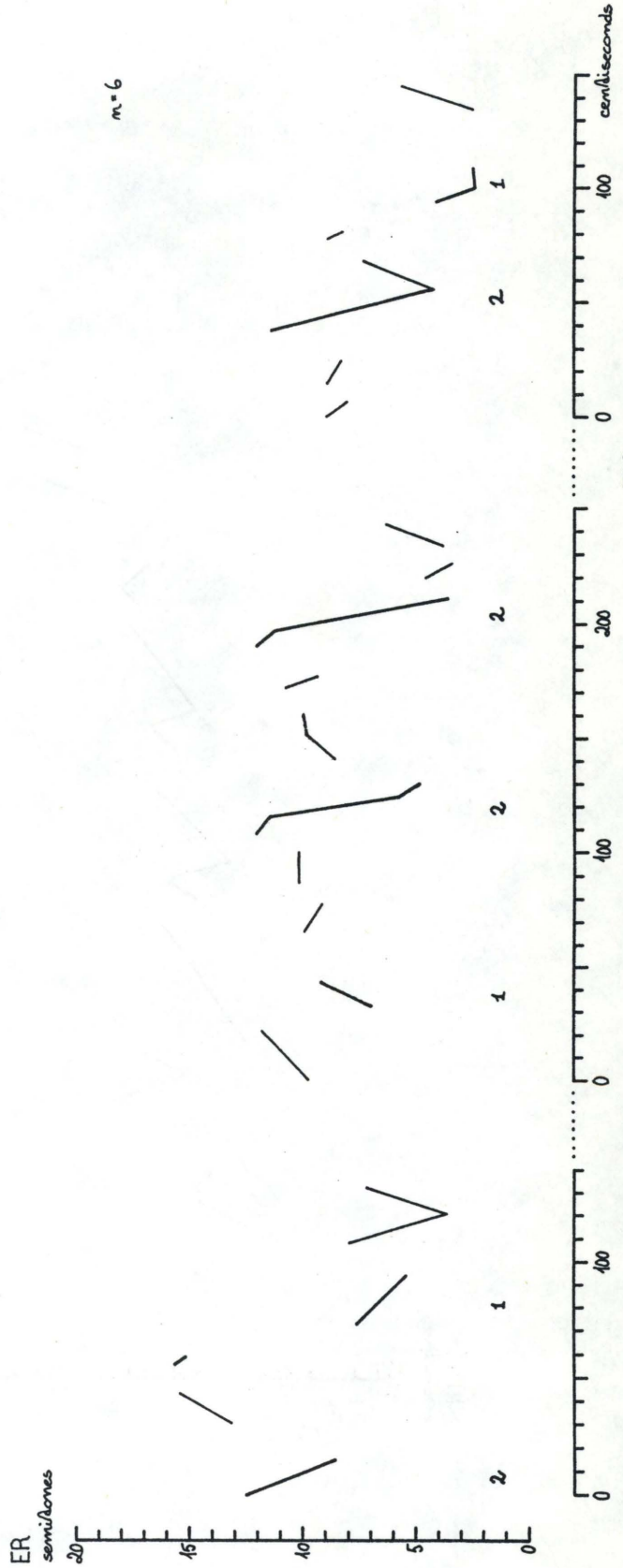

m-6
ER
semitones
20
15
10
5
0
2
1
2
1
2
1
2
1
0
100
200
100
0
100
0
40.2 cs
70.8 cs
centiseconds

Figure 27

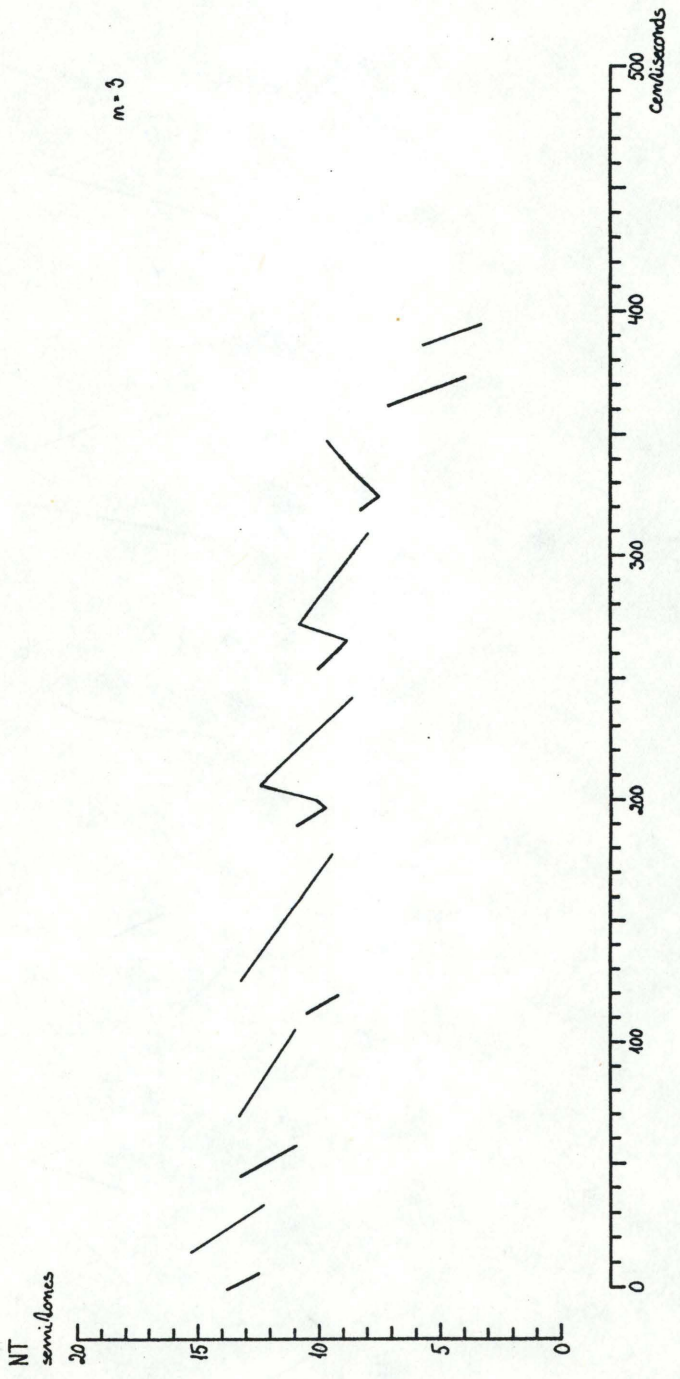


Figure 28

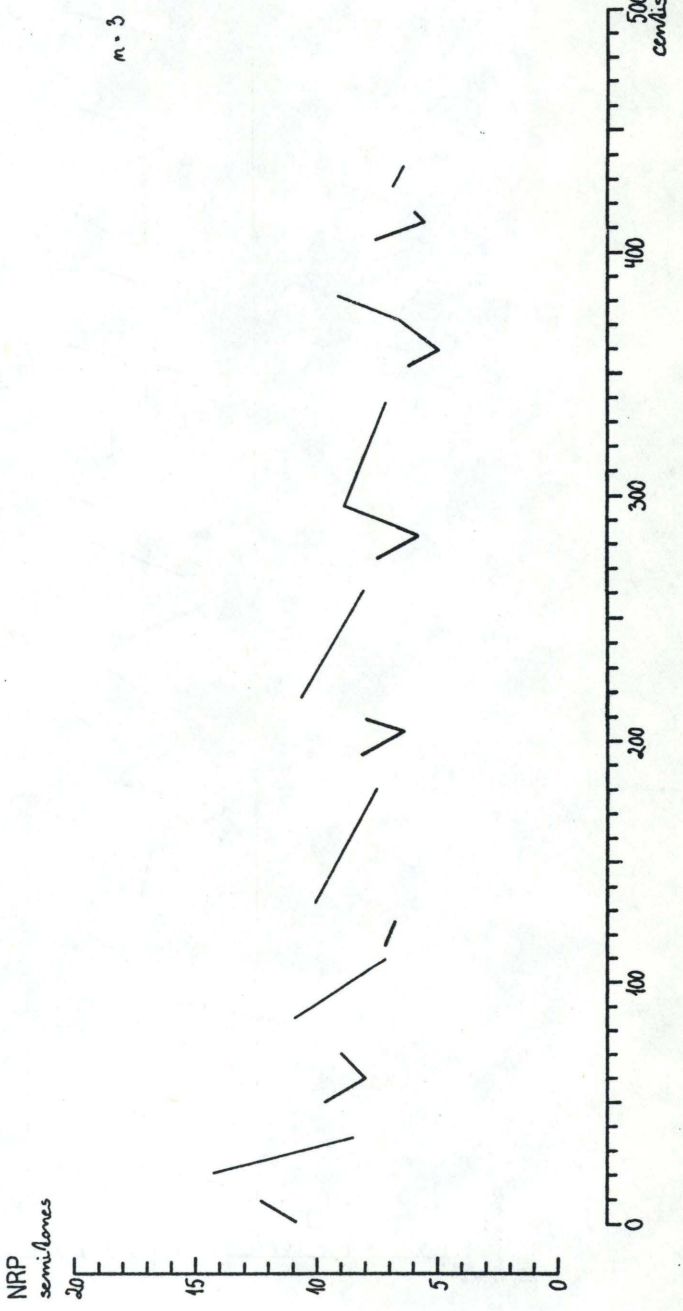

m·3
NRP
semitones
20
15
10
5
0
0
100
200
300
400
500
centiseconds

Figure 29

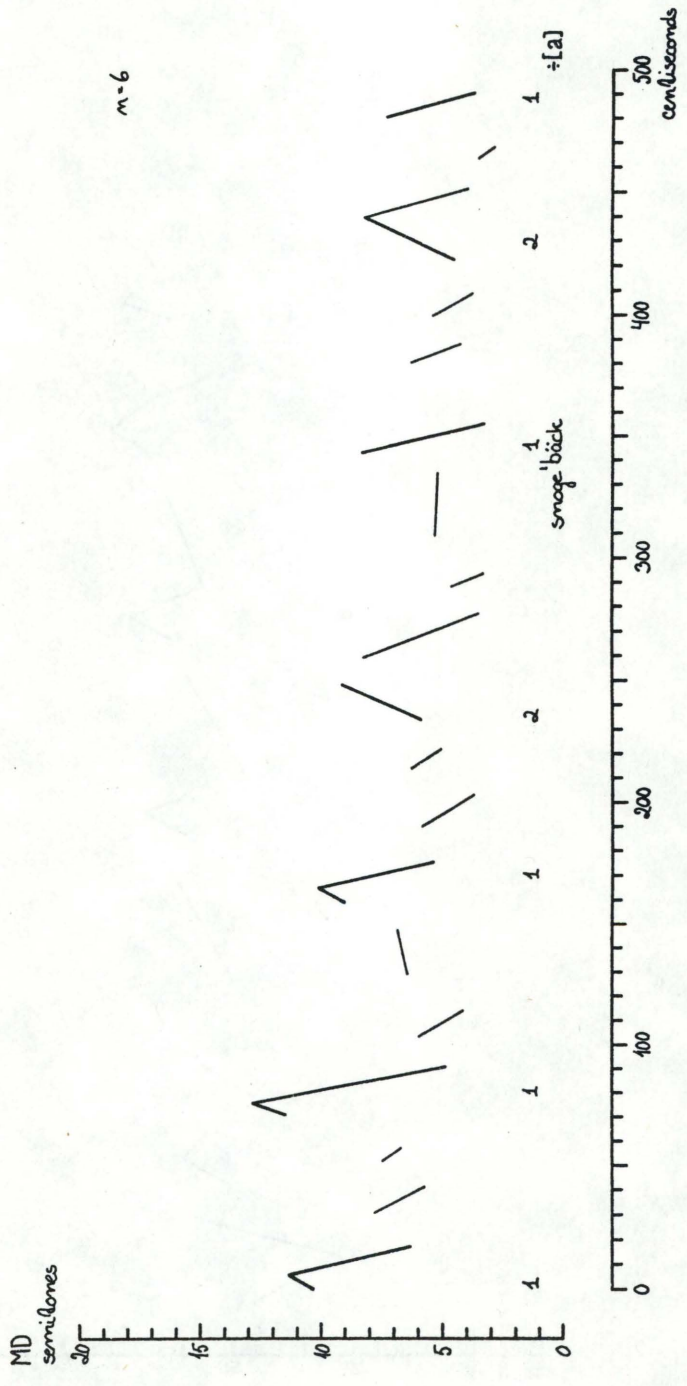

m-6
MD
semitones
20
15
10
5
0
1
1
1
2
1
2
1
smoge'böck
÷[a]
0
100
200
300
400
500
centiseconds

Figure 30

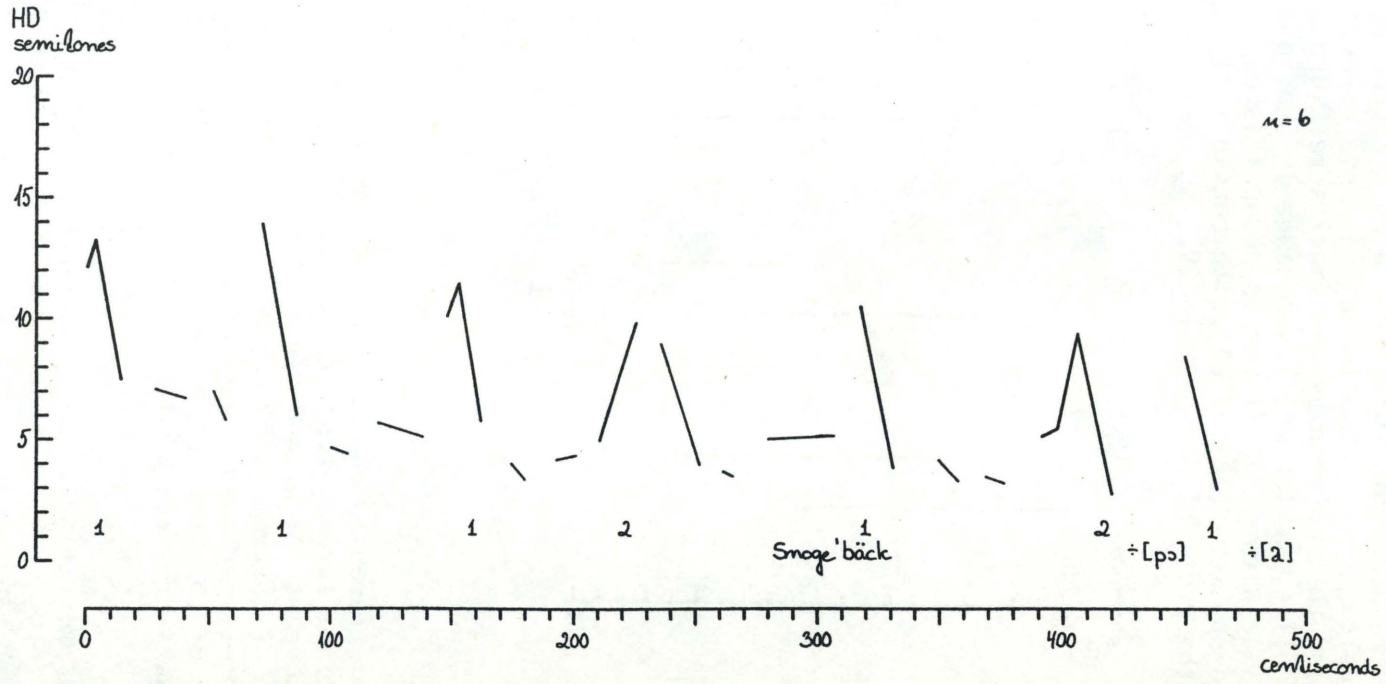

HD
semitones
20
15
10
5
0
n = 6
1
1
1
2
1
2
1
Snoge'bäck
÷[pɔ]
÷[a]
0
100
200
300
400
500
centiseconds

Figure 31

Part of the reason for the apparent step up here is that the final unstressed vowel could not be measured with MD and HD, due to highly irregular creaky voice vibrations but, obviously, when you look at how post-tonic syllables behave in Malmö, a final measurement would not have brought the average anywhere near 5 semitones lower than the preceding low Fo. - The difference between utterances with and without sentence accent is also very apparent: with no sentence accent (group II) there is hardly any overlap between the range covered by the first part and that covered by the final stress group in the utterance. (The smaller and lower range in the initial part of the utterance with group II versus group I is due to the inclusion of two speakers (IB and CA) with considerably narrower ranges than the rest, cf. also table IV.)

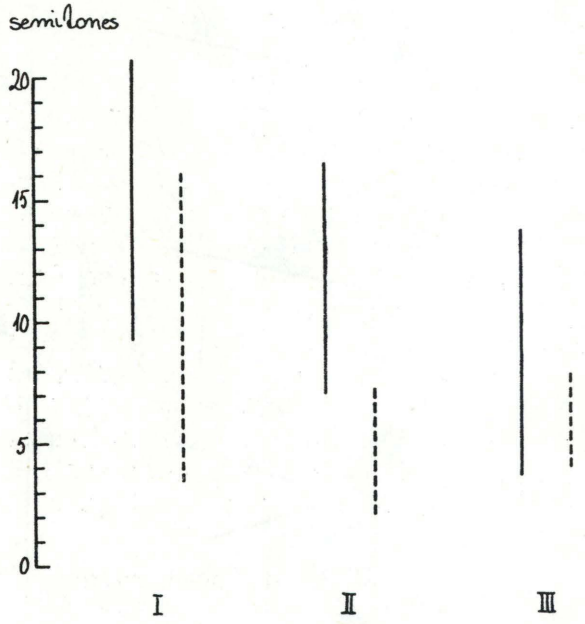


Figure 32

Range covered by the first six stress groups (full lines) and the final stress group (broken lines) in figures 19-31. Group one consists of HP and BjH (figure 19 and 26), group two consists of the remaining six Bornholm speakers (figures 20-25) and one Copenhagen speaker (NT, figure 28), group three consists of the other Copenhagen speaker (NRP) and two Malmö speakers (figures 29-31). See further the text.

(iii) Resettings. As noted above, some speakers appear to have slight resettings of the intonation contour, and some do not. With MD and HD (figures 30 and 31) no breaks in the global trend appear. Three speakers, HC, CA, IB (figures 20, 21, 22) perform a rise from the first to the second stress group and an even fall thereafter. ER (figure 27) is excessive in the other direction: she has three clearly distinct (not just by the pauses between them) prosodic

phrases, each with its own overall fall, of which the last one appears to be steeper than preceding ones. As also noted above, ER did not produce any default sentence accents here, and the fall within each prosodic phrase lies across the stressed syllables, rather than within the last stressed syllable in each phrase. This is an entirely different mode from the other Stockholm speaker (and the Bornholm speakers) and also different from her own production in the Kamma-utterances. Again, I can only repeat that speech production is subject to a considerable variability, and different styles or "readings" may wreak havoc with what linguists and phoneticians otherwise consider as deeply rooted phenomena, in casu phrasal intonation and default sentence accent. If I were to hazard a characterisation of ER's reading of this long utterance, I would say that it was slow and very deliberate as if wishing to impregnate on the listener the importance of every word, though entirely unemotional.

Seven speakers (HP, JT, RK, KP, BjH, NT, NRP) came out with a slight resetting of the intonation contour, namely a skip up between the third and fourth stress groups, i.e. after the verb phrase, before the complement of place. There is nothing surprising in this, and I have found similar trends in Copenhagen in general (Thorsen, 1983). And, as in the Copenhagen material, although the resetting is associated with a syntactic boundary, it is not exactly coincident with it. The syntactic boundary (//) occurs before 'fra/från' ('... med rutebilen// fra Gudhjem .../ ... med bussen//från Gudhem...'), but no disruption of the smooth course through all the unstressed syllables can be detected, i.e. the initial unstressed word in the complement ties up prosodically with the final stress group in the preceding verb phrase.

(iv) Preplanning? I have argued previously (Thorsen 1983, 1984, 1985, 1986a, 1986b) that the globally falling sentence intonation contours of Standard Copenhagen cannot be satisfactorily accounted for without the assumption of a look-ahead and pre-planning mechanism in their actual production (as opposed to a claim that global trends are the result of the iterative application of local rules, which are sensitive only to preceding, not succeeding, events, cf. Pierrehumbert, 1980, 1983, and Liberman and Pierrehumbert, 1984). It would seem a priori more likely that utterances with a moderate declination, prior to a steep final fall, could be accounted for without much pre-planning on the part of the speaker. The gentle pre-final declination would then be ascribed to physiological (automatized) factors. However, the pre-final declination is - with some speakers (HP, HC, JT, RK, KP) - rather considerable, and it remains to be seen whether its slope may not be sensitive to duration, which would bear testimony to a pre-planning based on the number of up-coming events (number of stress groups). Likewise, a resetting of the contour does not make much sense if the speaker is not supposed to know - during the production of the utterance - how much material is still left.

(v) Stress group patterns. A final note about stress group patterns, which cut up the Bornholm speakers in yet a different grouping: HP, HC, and CA have the familiar (from the Kamma-utterances) low-falling + rising pattern. JT, RK, and KP do differently here: the low fall in the stressed syllable is succeeded by an abrupt rise to the onset of the first post-tonic, and the post-tonics then remain high or fall slightly after that with JT and RK, whereas they fall steeply with KP. IB follows the pattern set by HP, HC, and CA in some of his utterances, while in others he reverses the pattern into a high-rising + falling one. Thus a total of three different Fo patterns are attested: falling-rising (very common), rising-falling (not frequent), and falling-falling. (If nothing else will, this should convince the reader that present-day Bornholm does not have any word tone distinction à la Swedish.) - These differences may be ascribed to different readings, which created the impression of a neutral attitude from HP, HC, and CA, whereas JT, RK, KP and IB's reversed editions sounded more insistent, but of course it would take Bornholm speakers to ascertain these impressions.

To sum up: Stockholm and Bornholm signal terminal declarative sentence intonation mainly through the steep fall in the final stress group (added to the word accent pattern in Stockholm, obtained by an inversion of the stress group pattern in Bornholm), with gently sloping contours preceding the fall. Again, Malmö and Copenhagen team up (if previously published data on long sentences in Copenhagen is considered, and NT is ranked as an exception to the general tendency) with a global, overall falling contour where the final stress group does not deviate from preceding ones in terms of the direction or extent of its Fo movement.

(b) The questions (figures 33-45):

The question with question word was produced with three stressed syllables (no stress on 'er/är') by KP, IB, and partly HD; five stressed syllables (also stress on 'hvor') by HP and RK, four stresses by the rest. Five Bornholm speakers have no prosodic signalling of the interrogative function: HP, CA, JT, RK, and KP,

Figures 33-45

Average fundamental frequency tracings (logarithmic display) of a question with question word, succeeded by an echo-question. Seven Bornholm speakers, two Stockholm speakers, two Copenhagen speakers, and two Malmö speakers. Bornholm speakers recorded the utterances as indicated in figure 33, Stockholm and Malmö speakers' utterances are indicated in figure 40, and Copenhagen speakers' in figure 44. The stressed syllables are drawn in thicker lines than the unstressed syllables. Deviation in stress-assignment is indicated with HP, IB, RK, KP, ER, HD. The number of items is given in the upper right of each figure. See further the legend to figures 19-31.

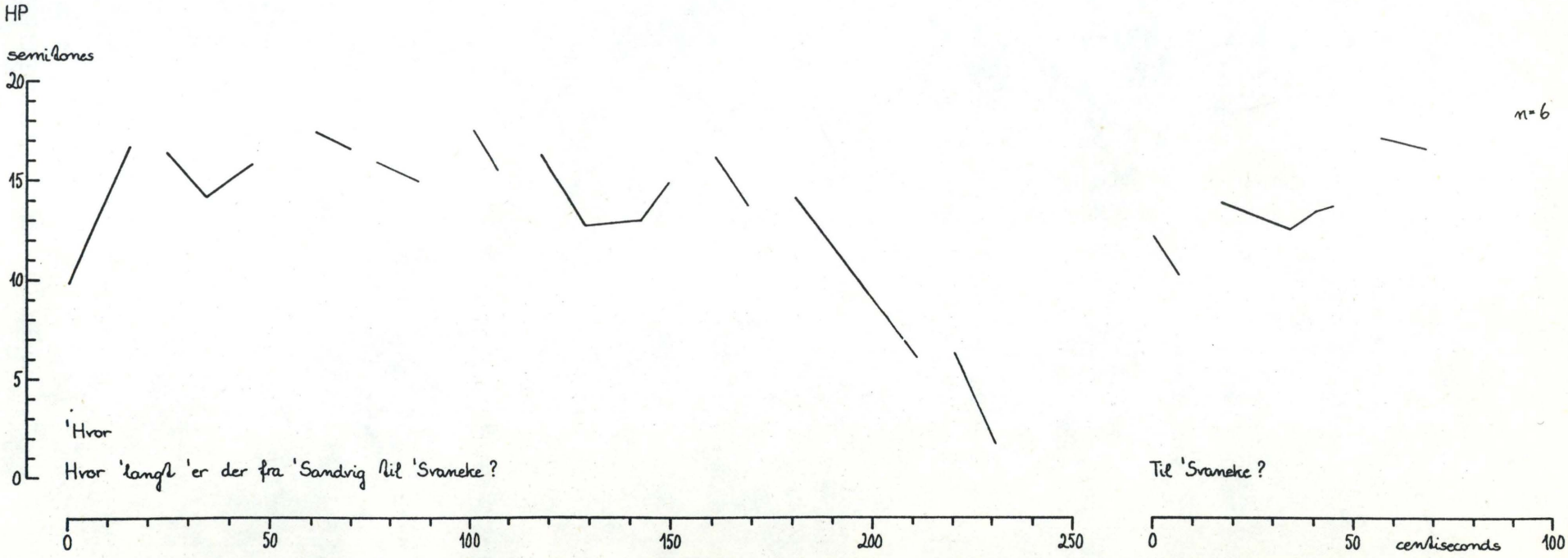

HP
semitones
20
15
10
5
0
n=6
'Hvor
Hvor 'langt 'er der fra 'Sandvig til 'Svaneke?
Til 'Svaneke?
0
50
100
150
200
250
0
50
centiseconds
100

Figure 33

m-6
HC
semilones
20
15
10
5
0
0
50
100
150
200
250
0
50
centiseconds
100

Figure 34

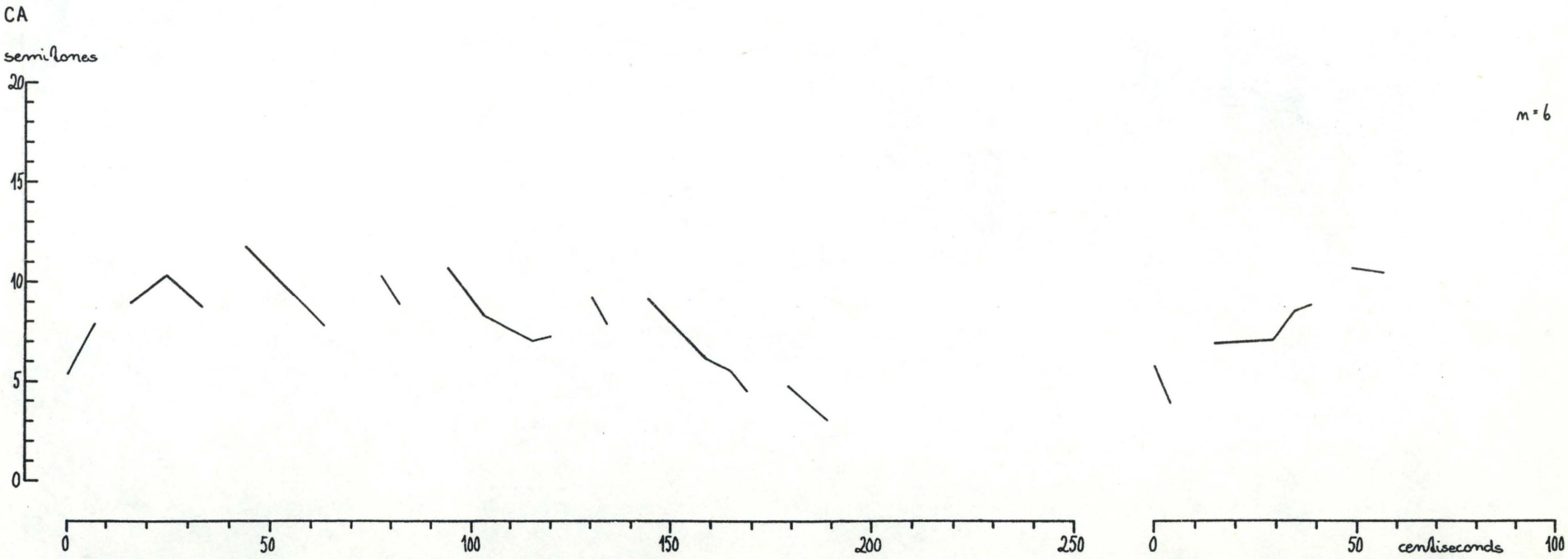

CA
semitones
20
15
10
5
0
m=6
0
50
100
150
200
250
0
50
centiseconds
100

Figure 35

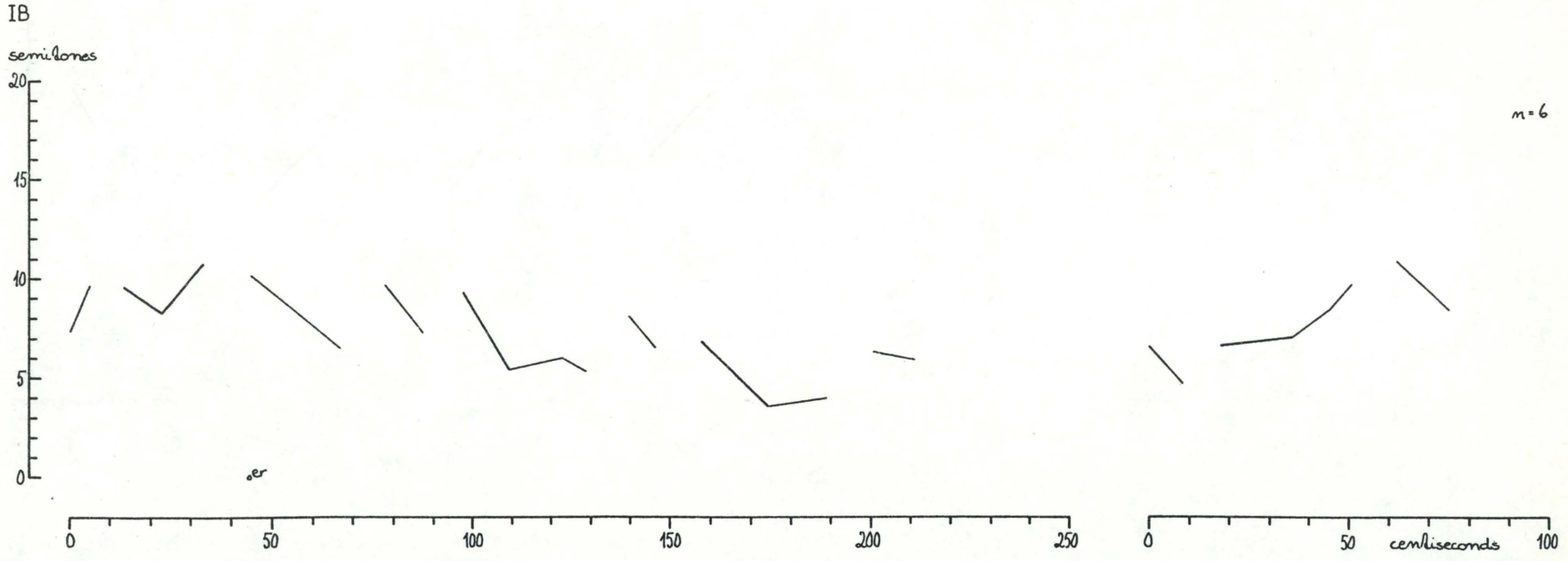

IB
semitones
20
15
10
5
0
n=6
0
50
100
150
200
250
0
50
centiseconds
100

Figure 36

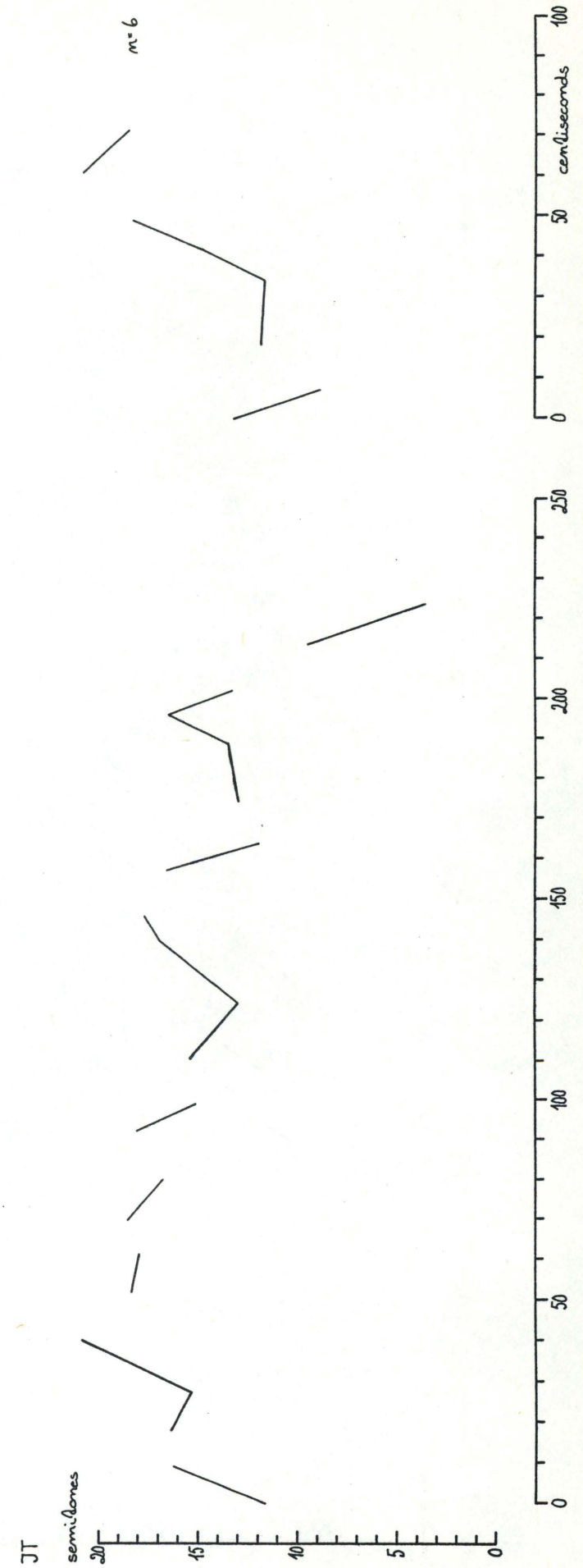

JT
semitones
20
15
10
5
0
0
50
100
150
200
250
m-6
0
50
100
centiseconds

Figure 37

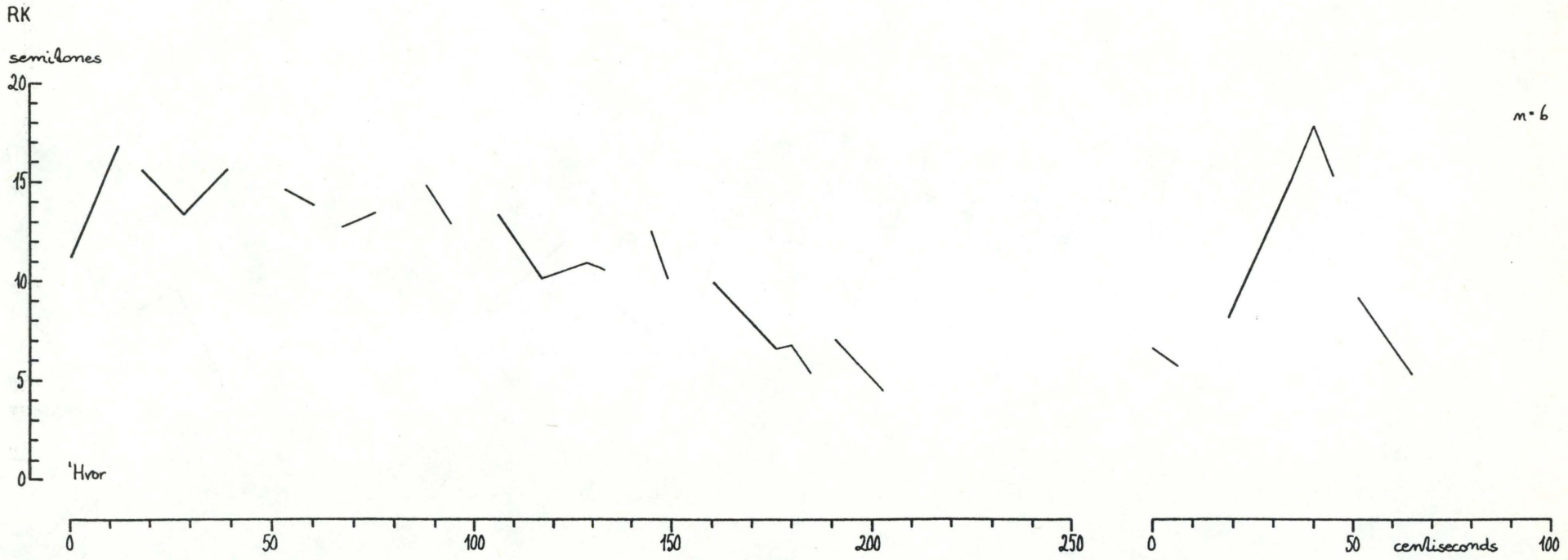

RK
semitones
20
15
10
5
0
'Hvor
0
50
100
150
200
250
m-6
0
50
centiseconds
100

Figure 38

KP
semitones
20
15
10
5
0
0
50
100
150
200
250
centiseconds
0
50
100
m-6
.er

Figure 39

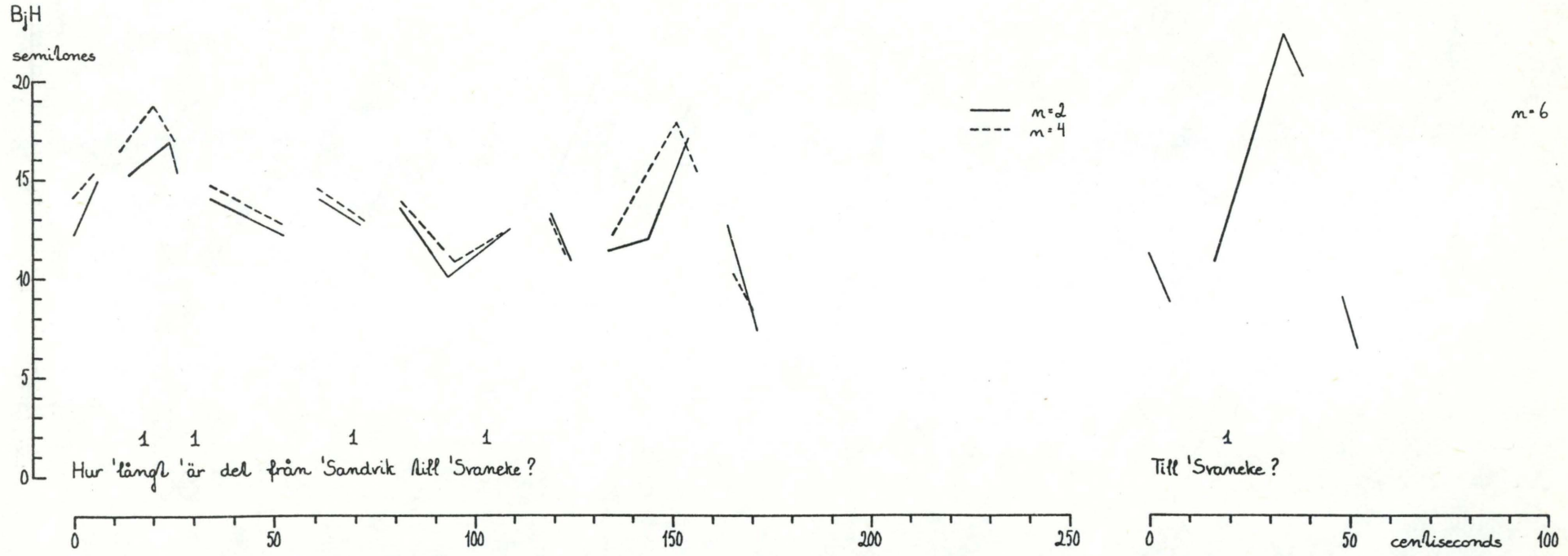

BjH
semitones
20
15
10
5
0
n=2
n=4
n=6
1 1 1 1
Hur 'långt 'är det från 'Sandvik till 'Svaneke?
1
Till 'Svaneke?
0
50
100
150
200
250
0
50
centiseconds
100

Figure 40

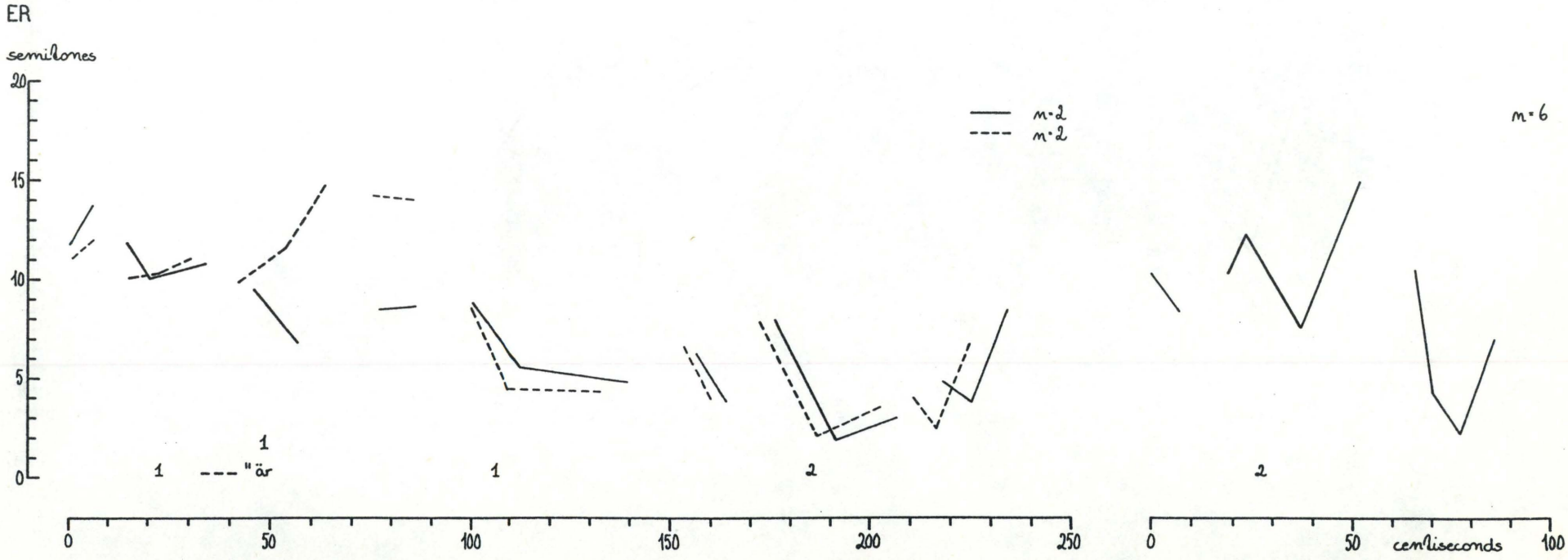

ER
semitones
20
15
10
5
0
n=2
n=2
n=6
1
1 --- "är
1
2
2
0
50
100
150
200
250
0
50
centiseconds
100

Figure 41

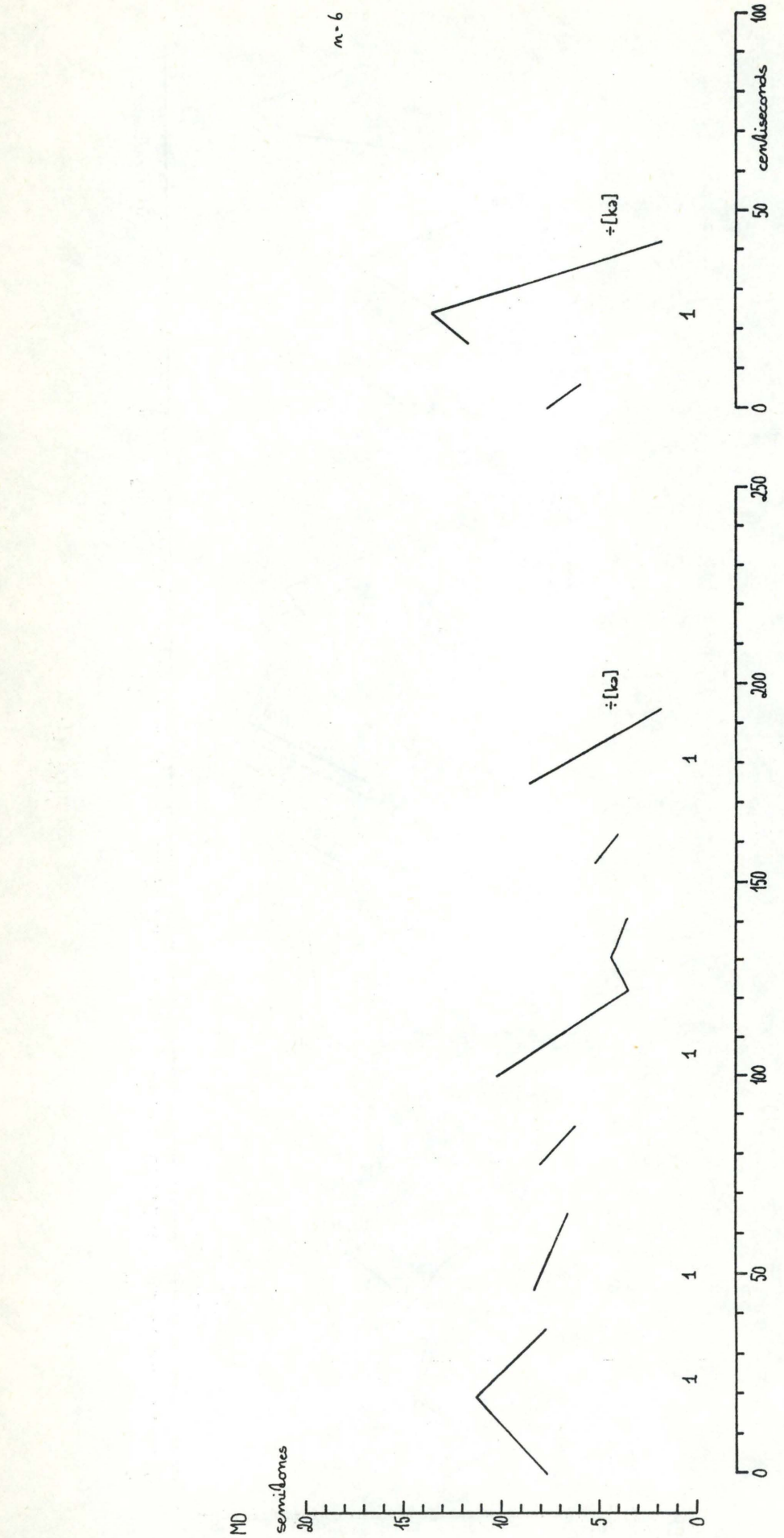

MD
semitones
20
15
10
5
0
1
1
1
1
1
0
50
100
150
200
250
÷[ka]
÷[ka]
m-6
0
50
100
centiseconds

Figure 42

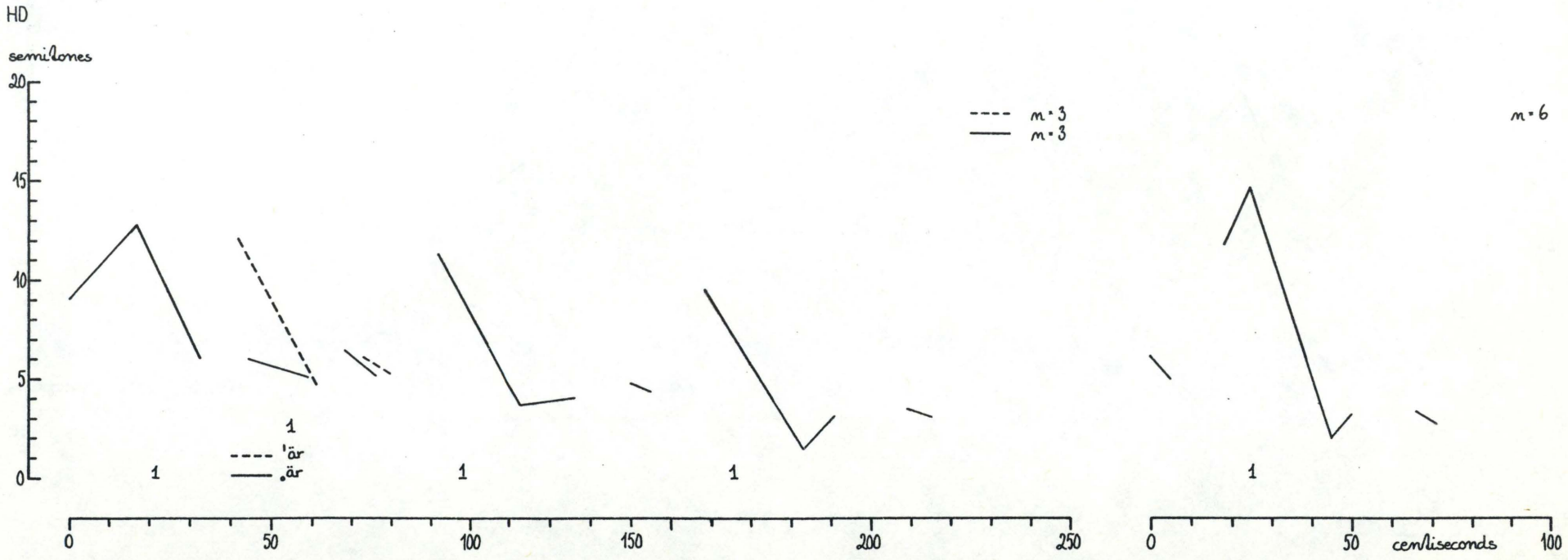

HD
semitones
20
15
10
5
0
m·3
m·3
m·6
1
'är
•är
0
50
100
150
200
250
centiseconds

Figure 43

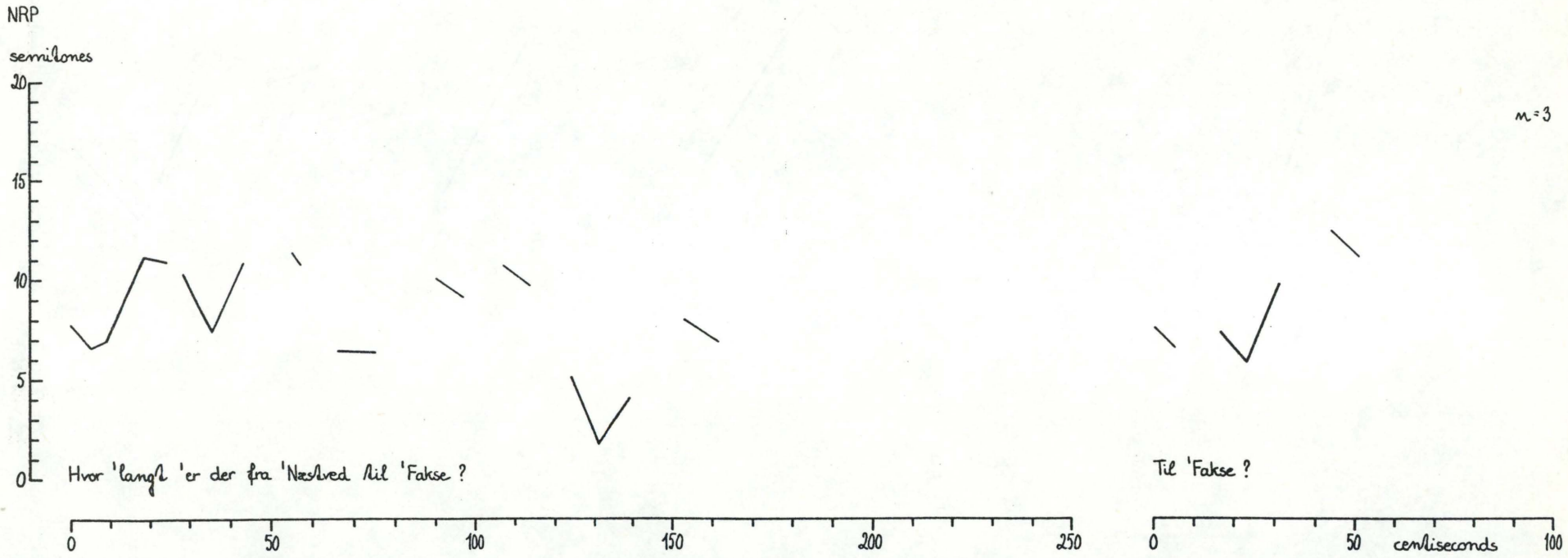

NRP
semitones
20
15
10
5
0
Hvor 'langt 'er der fra 'Næsved /til 'Fakse ?
0
50
100
150
200
250
n=3
Til 'Fakse ?
0
50
centiseconds
100

Figure 44

n=3
NT
semitones
20
15
10
5
0
0
50
100
150
200
250
0
50
100
centiseconds

Figure 45

i.e. these utterances look exactly like terminal declaratives, with a final default sentence accent by HP and JT, without it by CA, KP, and RK. Two speakers turn the very final fall - through the last post-tonic - into a rise, i.e. they signal the interrogative function with a local, final (rising) movement: HC and IB; and all of the preceding utterance resembles exactly the declaratives by HP, CA, JT, KP, and RK.

The four Copenhagen and Malmö speakers produce prosodic terminals, entirely in line with those described above. So does ER (Stockholm), and again she does not produce a final default sentence accent: compare this edition with accented 'Svaneke' in figure 11 with its rapid rise in the first post-tonic syllable succeeded by an equally rapid fall to the second post-tonic (the terminal cue) and the final pre-pausal rise. What remains in figure 41 is the word accent fall and the pre-pausal rise. ER furthermore produced two items with a focal accent on 'är' which should guarantee that no sentence accent occurs finally: The final part of the two different renderings look exactly alike, except that the utterance with focal accent is shorter than the one without it. BjH uttered four items which I perceived as having a declarative intonation and two interrogative ones. The difference in the final part is slight and has to do with the relation between the stressed and first post-tonic: in the interrogative the stressed syllable is at the low onset of a rise that continues through the post-tonic (i.e. a low+high sequence), whereas in the declarative edition the stressed vowel rises more steeply and the high turning point is reached at the onset of the first post-tonic vowel, which is falling. This is not entirely in agreement with Gårding et al. (1974) who state that in Stockholm statements and questions have similar final configurations, only the accent peak is higher in questions.

Briefly, most speakers produced question word questions with declarative intonation contours, but those Bornholm and that Swedish speaker who did perform intonationally marked questions did so according to their local disposition: only the very last part of the contour deviates from a declarative one, i.e. the non-final Fo course carries no information about the interrogative function of the utterance. The option to produce declaratives intonationally is not open where the one-word echo question is concerned: but here the variability is impressive, a variation which may be attributed to differences in speaker attitude, or "reading": the high and rising pattern by HP, CA, IB, and JT sounded neutral to me, the low plus very high rise by HC transmitted an element of incredulity, and the rising-falling patterns (extensive by RK, less so by KP) sounded maybe somewhat gruff. Common to these questions is a feature of 'high' or 'rising'. The Stockholm Swedish speakers both conform well with Gårding et al. (1974): the pattern is undisrupted but the peak is considerably higher than in declaratives, reaching the upper end of the speakers' range. The Malmö speakers ought, according to Gårding et al. (1974) to have performed a rise in the final vowel. They do not do so here. The Accent I pattern is the same as in statements,

but it onsets from a considerably higher value and continues through the post-tonic. NRP and NT do not deviate from one word questions investigated previously (Thorsen 1978): the stress group pattern remains low plus high, but is transposed upwards relative to the location at the end of a declarative utterance.

C. ALIGNMENT OF SEGMENTS AND FUNDAMENTAL FREQUENCY

1. Compression or truncation

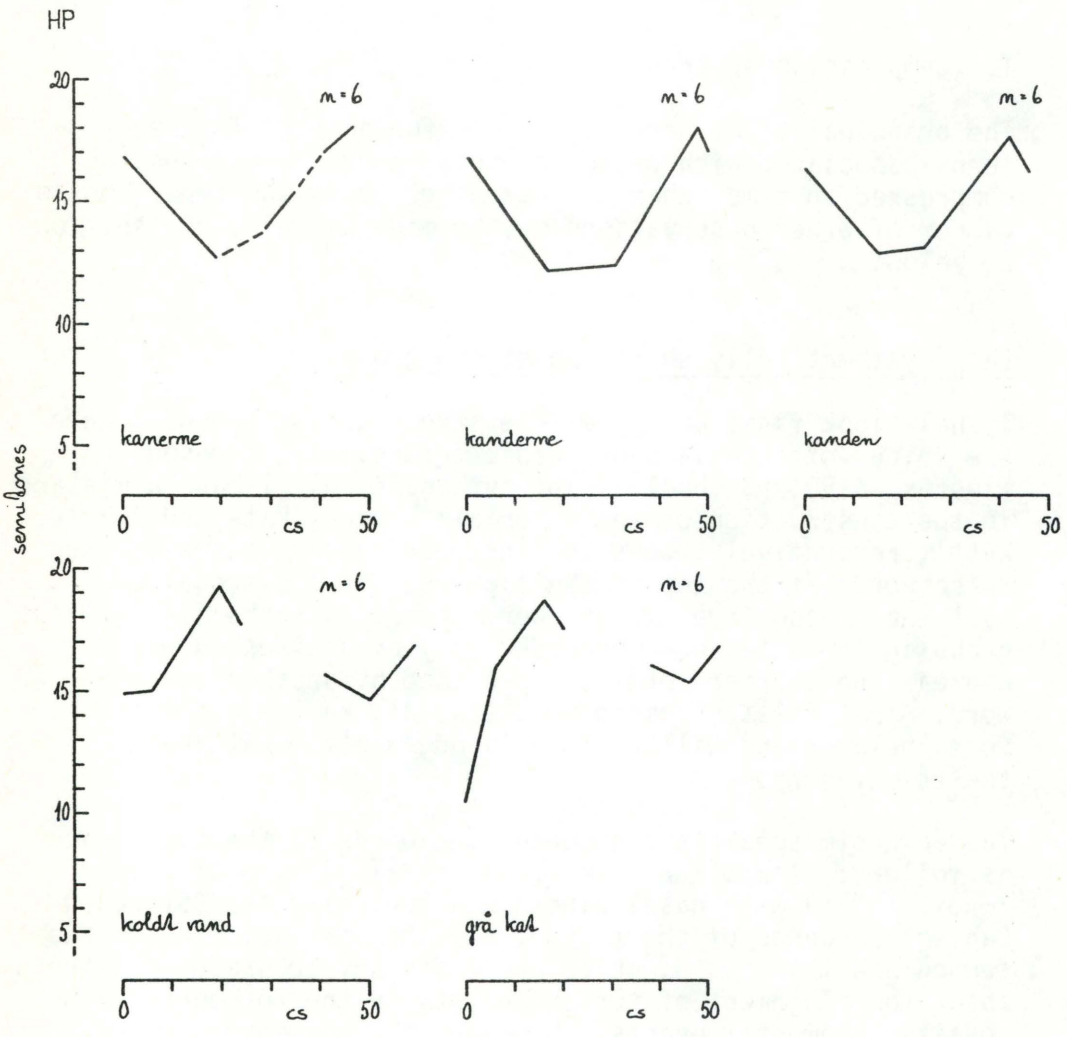
The principal issue here is whether fundamental frequency patterns associated with prosodic stress groups are truncated or compressed in time, when the stress group is shortened, but a number of other observations may be made as well, cf. section 2 below.

(a) Systematically shortened stress groups

I shall look first at those five stress groups (words) where the voiced stretch is shortened progressively, exposed in figures 46-58. I should point out again that I made a mistake in the construction of the material: 'vand, kat' and 'mjölk, katt', respectively, were the intended comparisons with the three words at the top of the figures, but I disregarded the fact that those three longer words constitute the first stress group in the utterance (preceded only by unstressed words), whereas the shorter words are preceded by another stressed word. That first stressed word ('koldt, kall - grå') is therefore included and will replace 'vand, mjölk - kat, katt' in the comparisons.

The Bornholm speakers pronounced the words in the five frames as follows: [ˈkʰɔ:nənə ˈkʰæ̃ɪ̃ʌnə ˈkʰæ̃ɪ̃ɐ̃ɪ̃ ˈkʰɔ·lt ˈvæ·n ˈgʁo· ˈkʰæt] with nasal diphthongs replacing the (Standard Danish) sequence of short vowel plus homosyllabic /n/ in the second and third word, which precludes any accurate statements about the alignment of turning points in the Fo course with specific segmental events. However, the consequences are not too grave.

Some segmental effects are very strong with some speakers: I attribute the uneven rise (steep and then less steep) in 'grå' with HP (figure 46) and IB (figure 49) to the uvular consonant [ʁ], and although it did not produce any discontinuities, the [gʁ-] versus [kʰ-] onset is probably responsible for the clean rise versus slight fall plus rise in the lower part of figure 47 (HC) and 52 (KP). JT (figure 50) runs counter to the other speakers, as far as the onset after the aspirated stop is concerned: a steep rise and then a fall-rise which could be superposed upon and coincide with the latter part of the fall-rise exhibited by the other Bornholm speakers.



Figures 46 - 58

Average fundamental frequency tracings (logarithmic display) of three words and two pairs of words, where the voiced stretch becomes progressively shorter through the frames, by seven Bornholm, two Stockholm, two Malmö, and two Copenhagen speakers. When the sonorant consonants could be delimited, they were drawn in broken lines. See further the legend to figures 1-7.

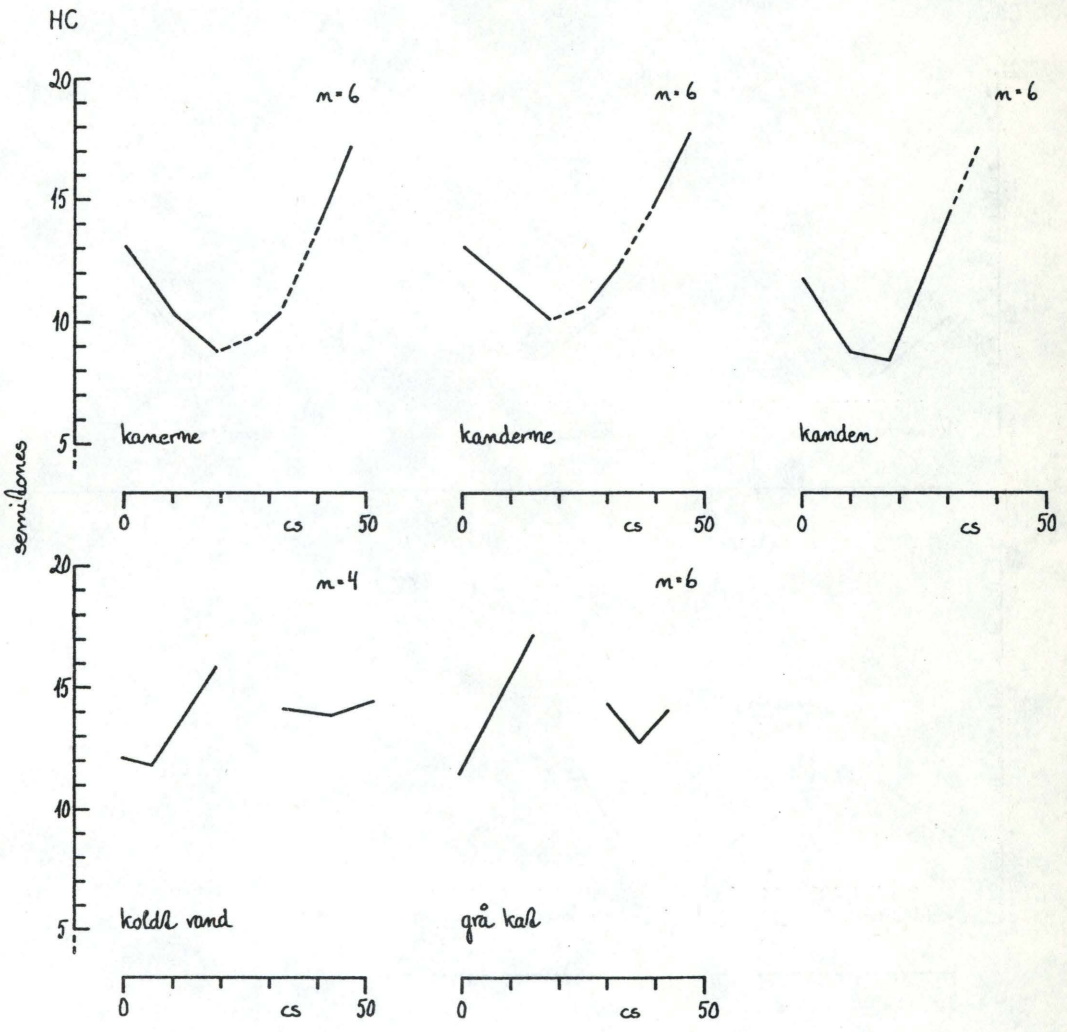

HC
semitones
20
15
10
5
m=6
kanerne
kanderne
kanden
m=4
koldk vand
m=6
grå kak
0
cs
50

Figure 47

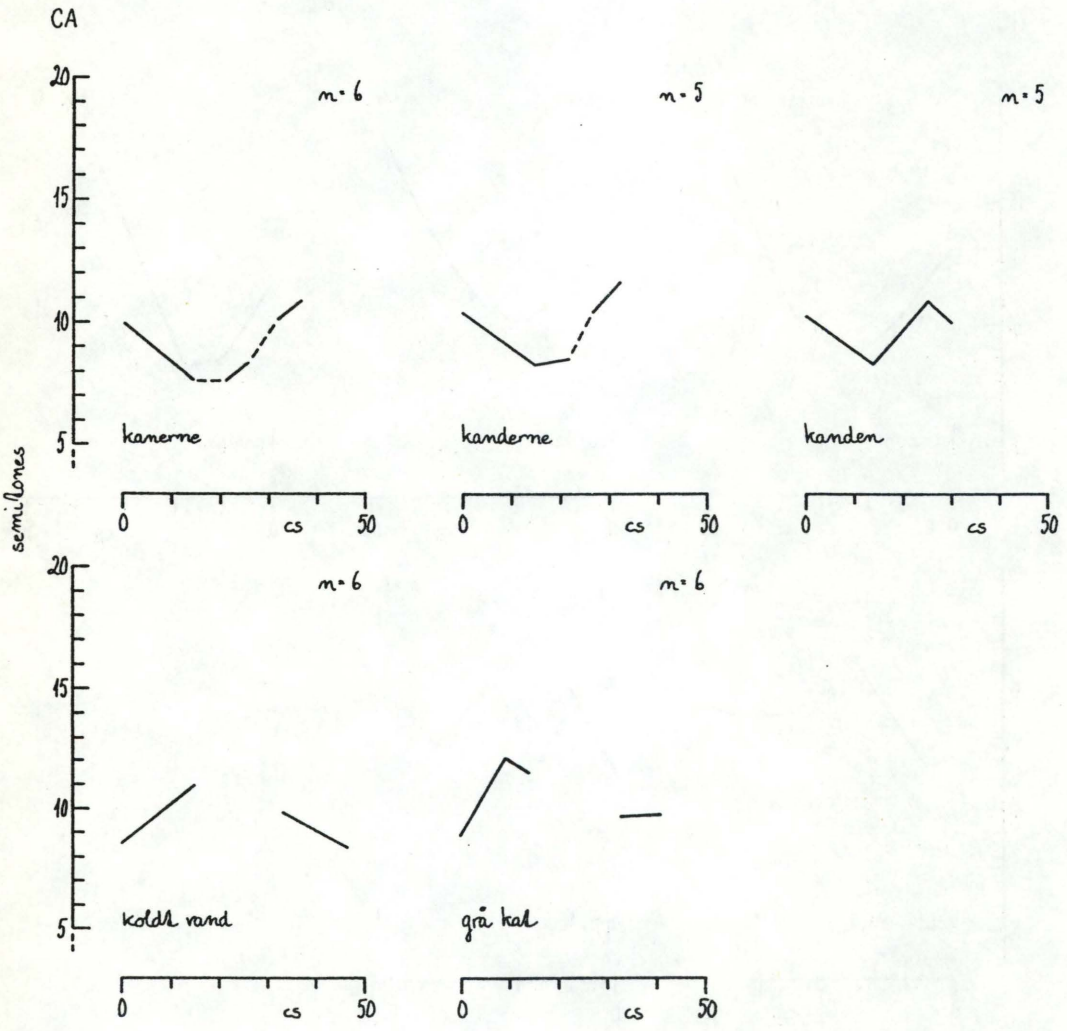

CA
semilunes
20
15
10
5
n = 6
n = 5
n = 5
kanerne
kanderne
kanden
0
cs
50
n = 6
n = 6
koldt vand
grå kat

Figure 48

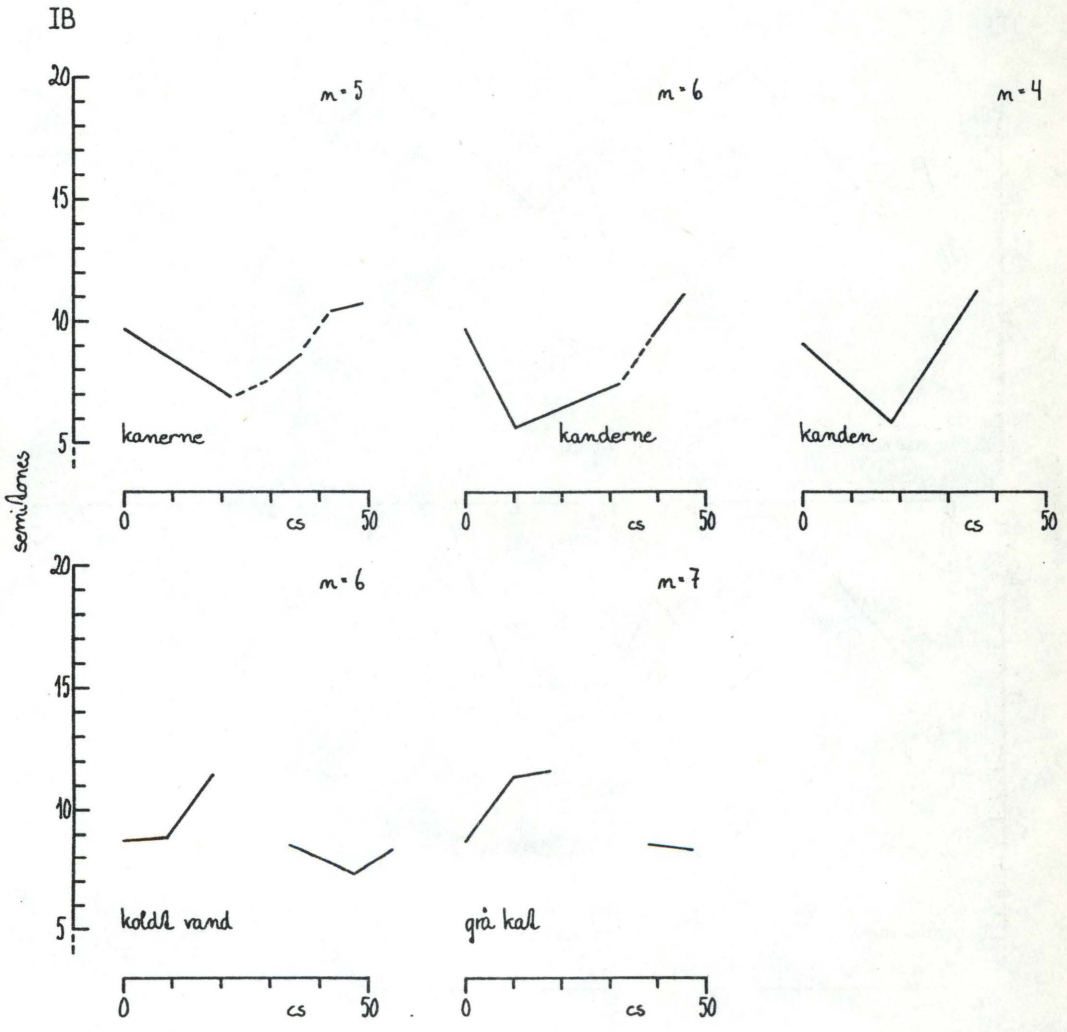

IB
semitones
20
15
10
5
m=5
m=6
m=4
kanerne
kanderne
kanden
0
cs
50
m=6
m=7
koldt vand
grå kat

Figure 49

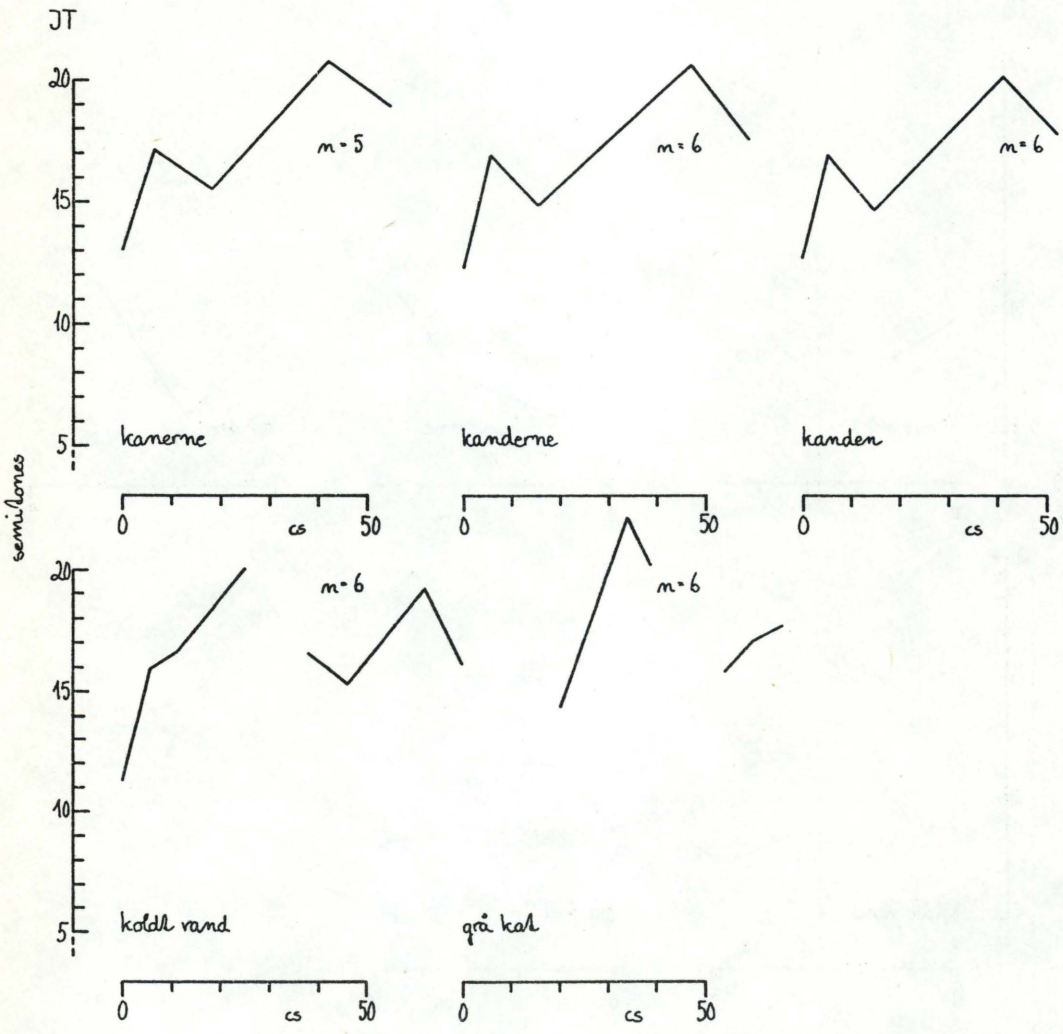

JT
semilunes
20
15
10
5
n = 5
n = 6
n = 6
kanerne
kanderne
kanden
0
cs
50
n = 6
n = 6
koldt vand
grå kar

Figure 50

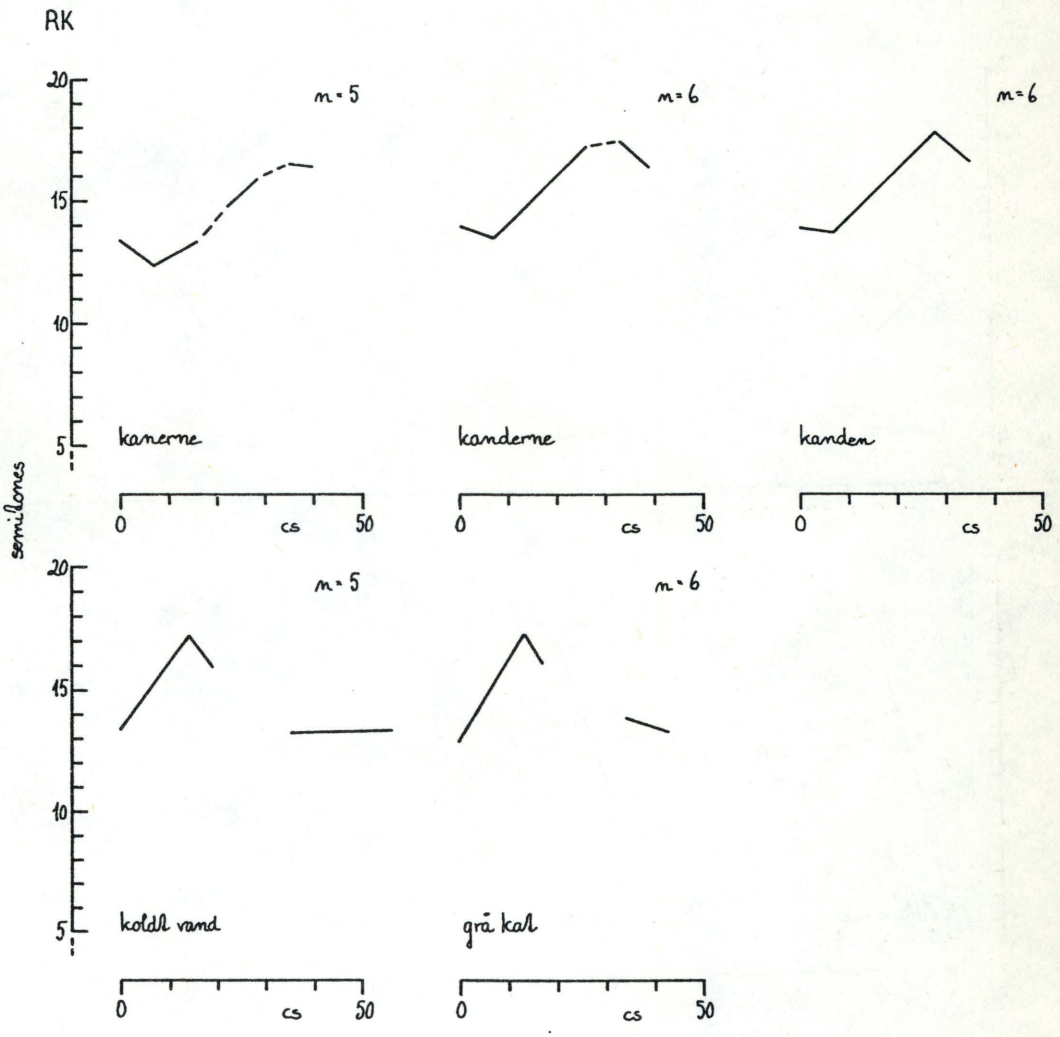

RK
semitones
20
15
10
5
m=5
m=6
m=6
kanerne
kanderne
kanden
m=5
m=6
koldt vand
grå kat
0
cs
50

Figure 51

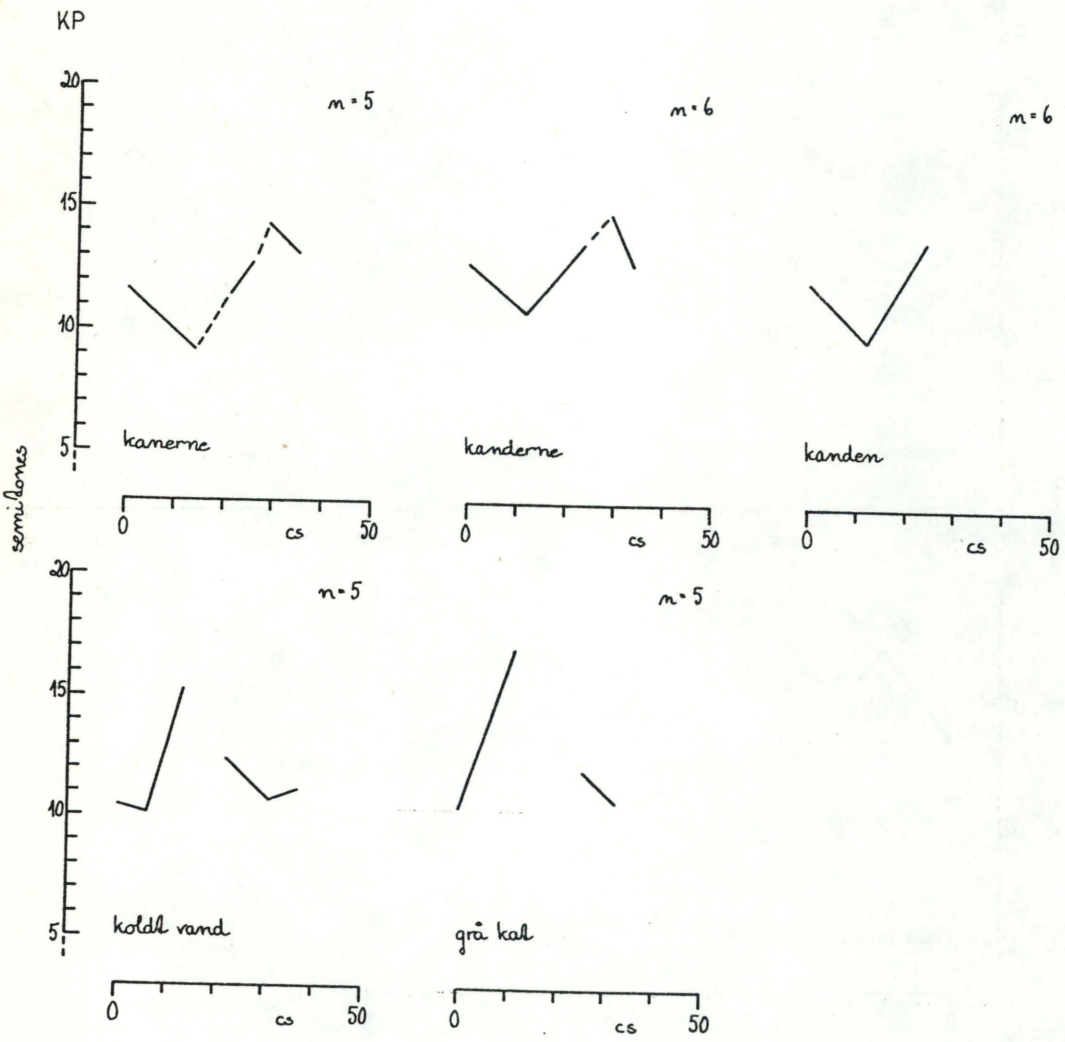

KP
20
15
10
5
n = 5
n = 6
n = 6
kanerne
kanderne
kanden
0
cs
50
n = 5
n = 5
koldt vand
grå kat
semildones

Figure 52

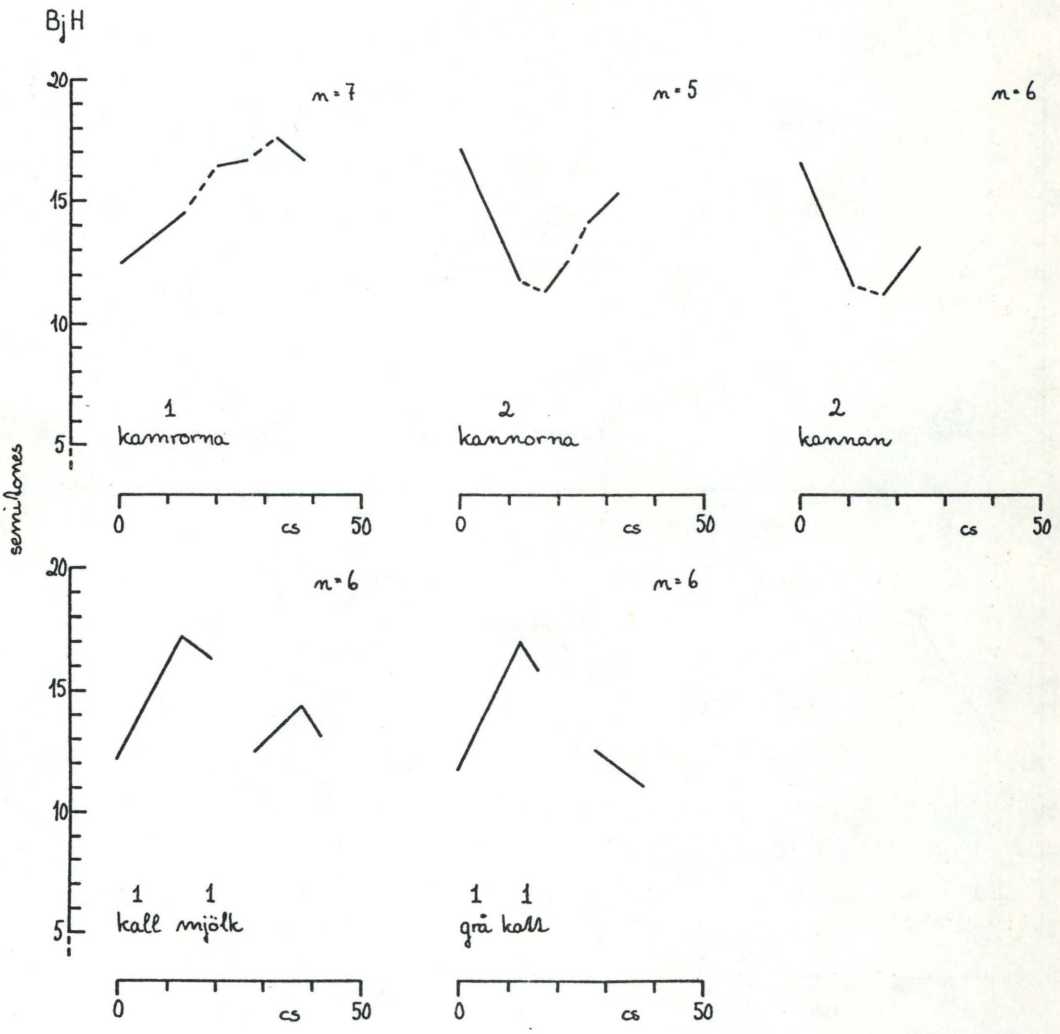

BjH
semitones
20
15
10
5
n = 7
1
kamrorna
n = 5
2
kannorna
n = 6
2
kannan
n = 6
1 1
kall mjölk
n = 6
1 1
grå kalk
0
cs
50

Figure 53

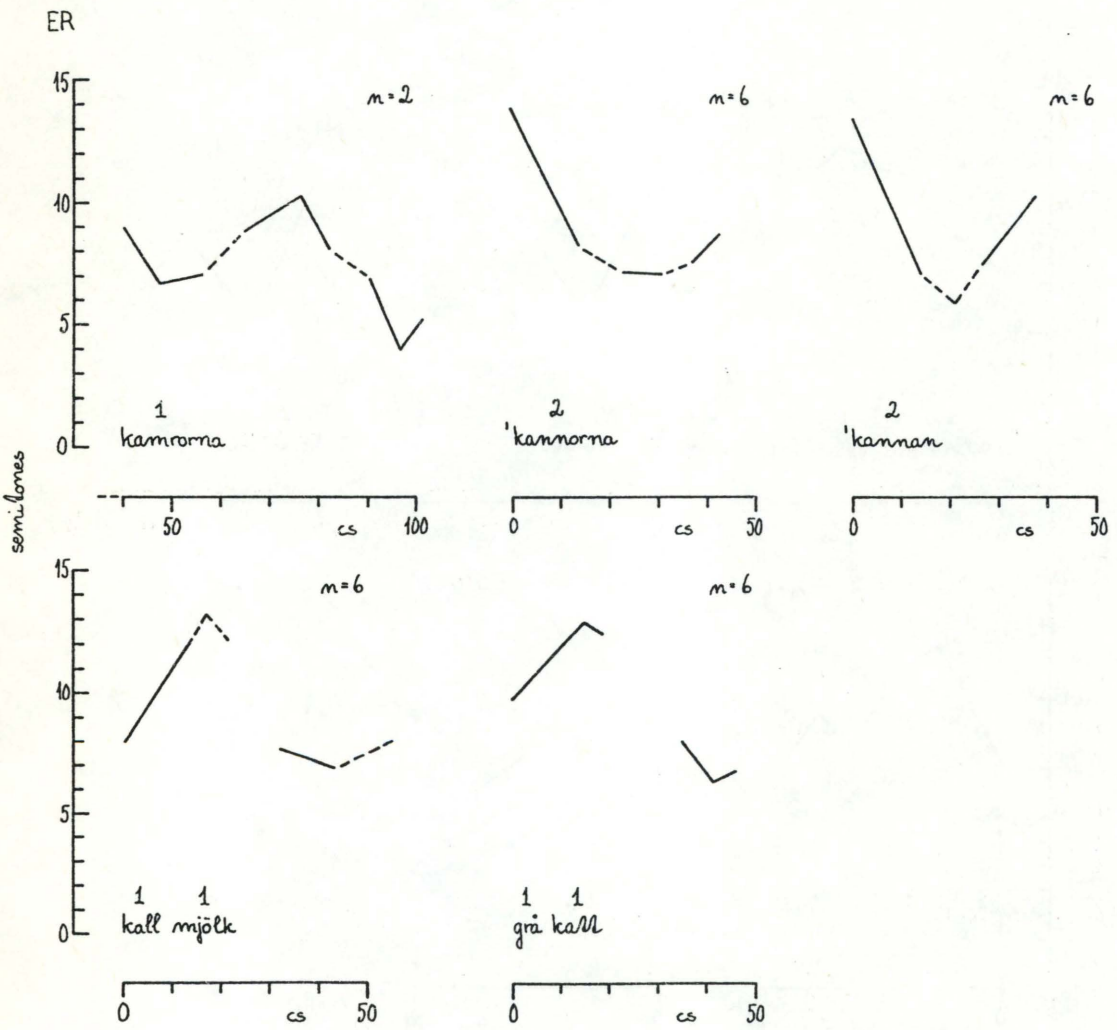

ER
15
10
5
0
n=2
n=6
n=6
1
kamrorna
2
'kannorna
2
'kannan
50
cs
100
0
cs
50
0
cs
50
n=6
n=6
1 1
kall mjölk
1 1
grå kall
0
cs
50
0
cs
50
similones

Figure 54

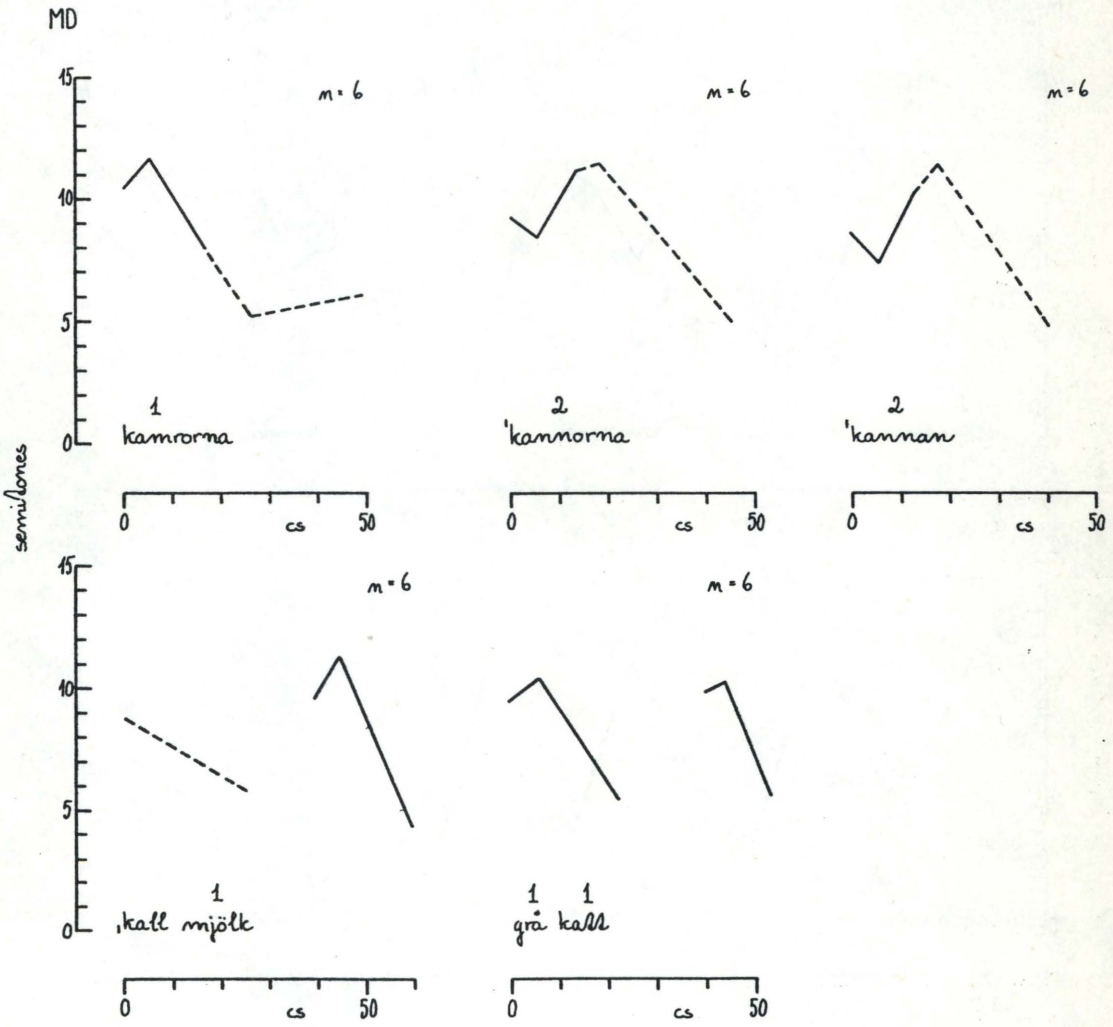

MD
semitones
15
10
5
0
m = 6
1
kamrorna
2
'kannorna
2
'kannan
1
,kall mjölk
1 1
grå kall
0
cs
50

Figure 55

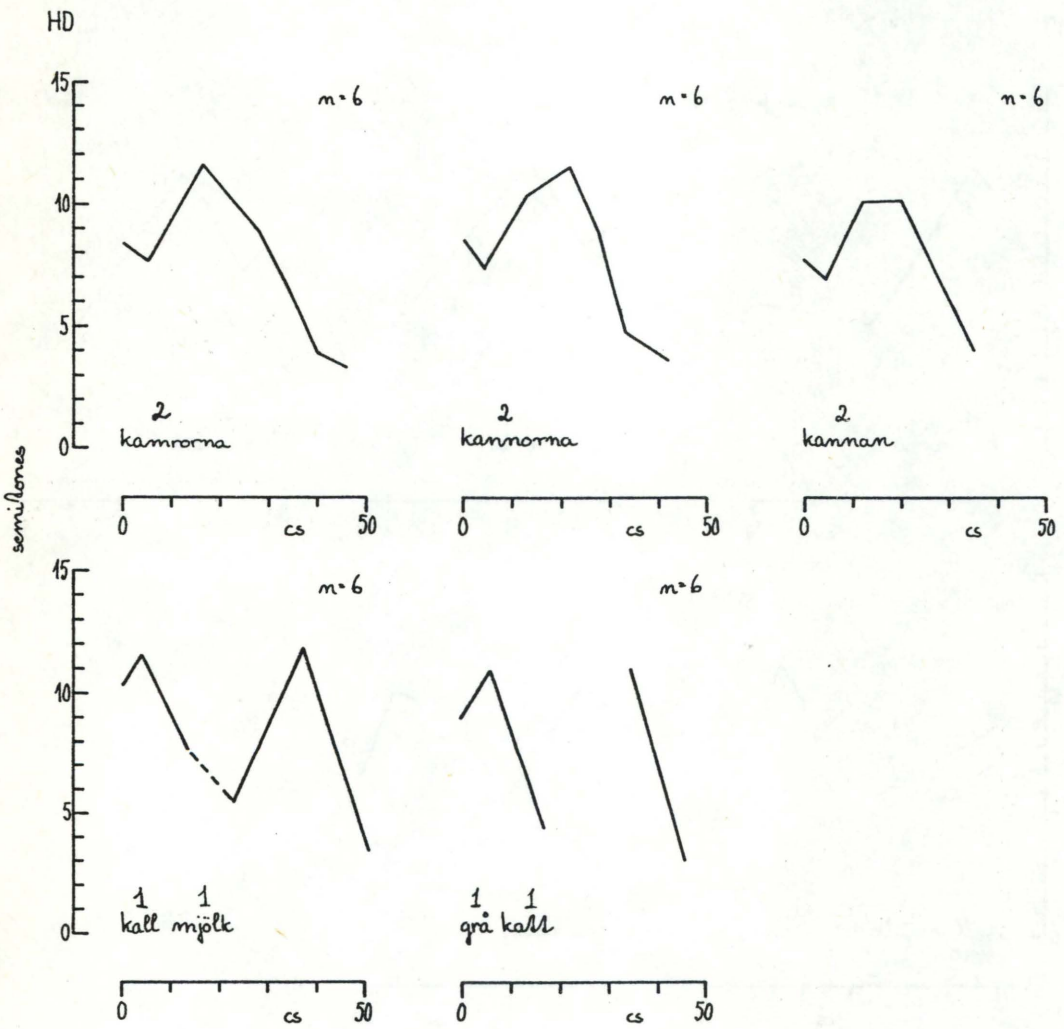

HD
15
10
5
0
n=6
2
kamrorna
0
cs
50
n=6
2
kannorna
n=6
2
kannan
semilunes
1
kall
1
mjölk
1
grå
1
kall

Figure 56

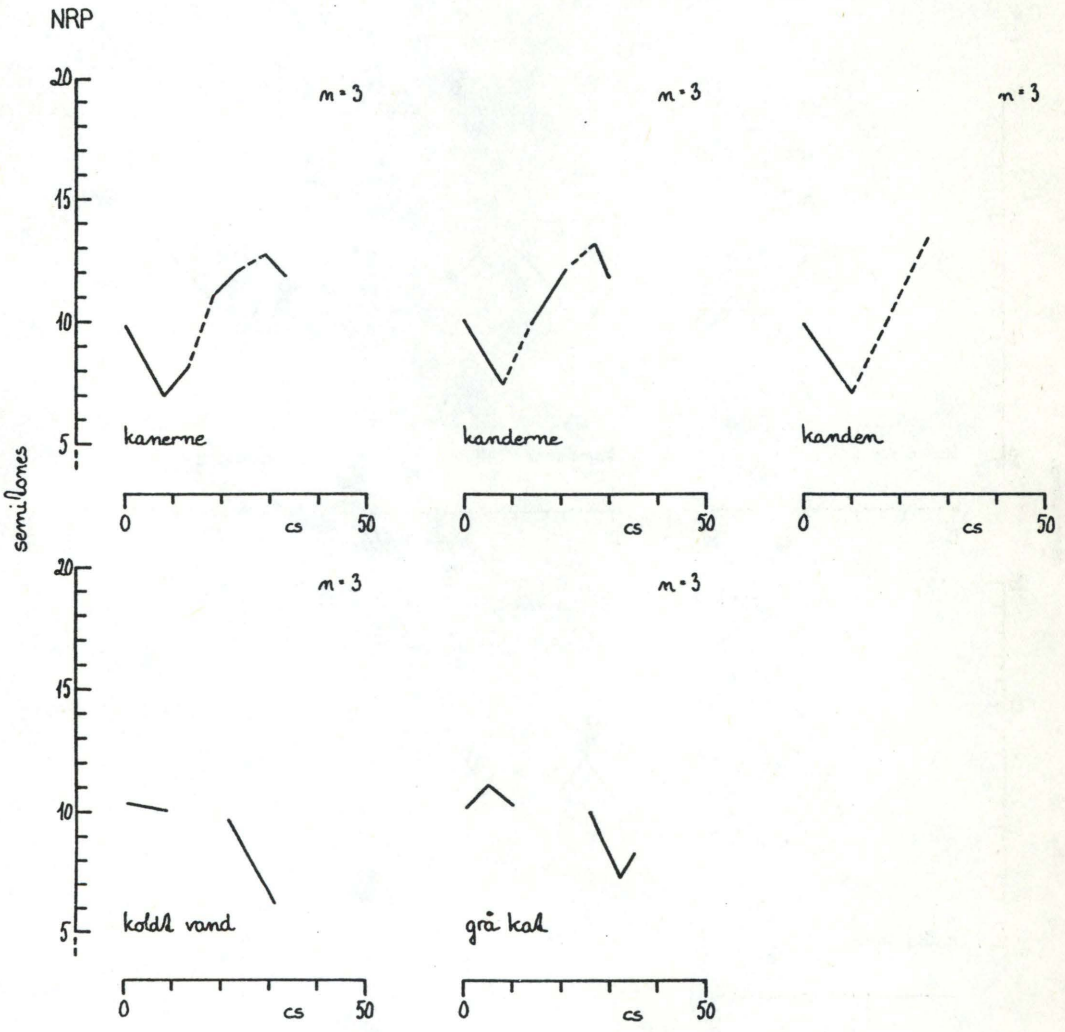

NRP
semitones
20
15
10
5
m = 3
kanerne
kanderne
kanden
koldt vand
grå kat
0
cs
50

Figure 57

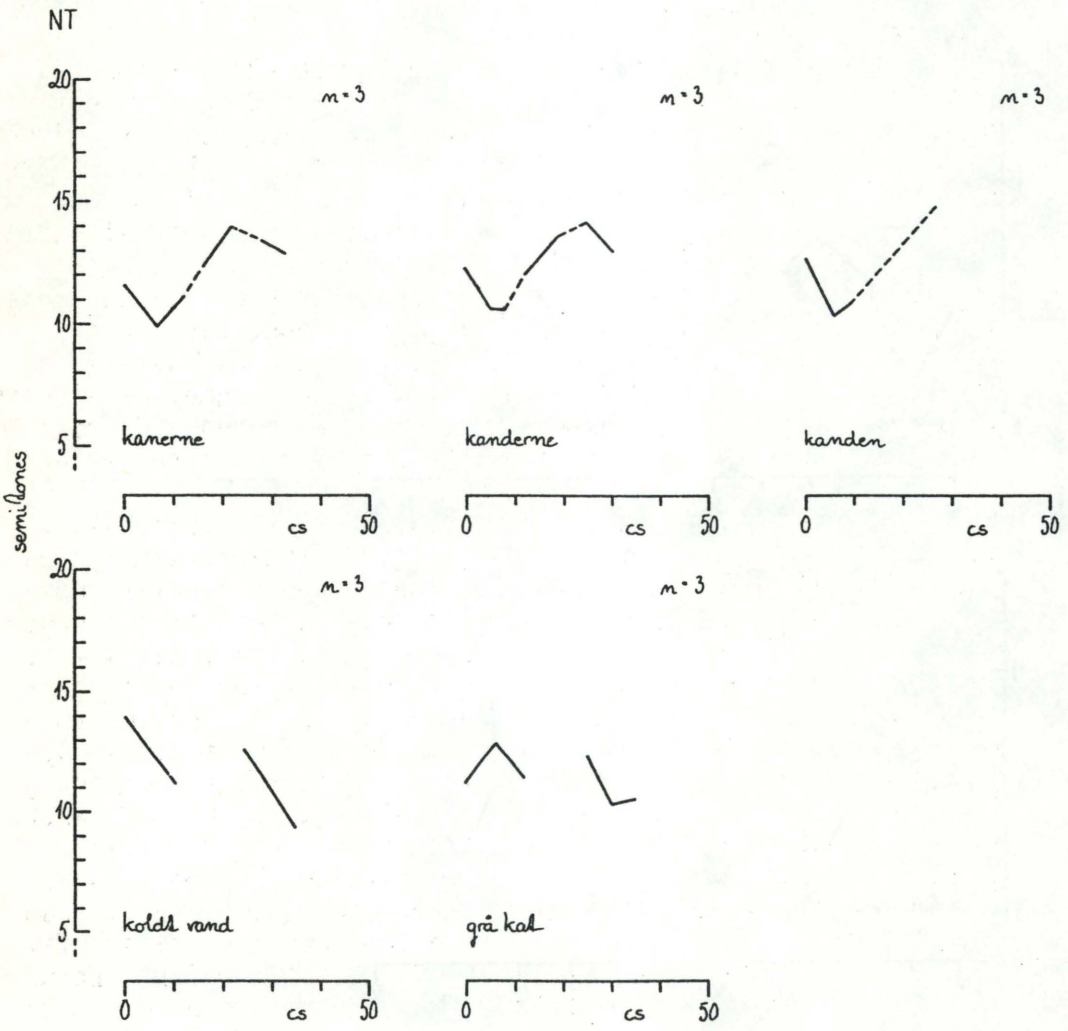

NT
semilames
20
15
10
5
n = 3
kanerne
kanderne
kanden
koldt vand
grå kat
0
cs
50

Figure 58

Inspection of JT's oscillogram and intensity curves reveals weak voicing in the beginning of the stressed vowel, i.e. the intensity is either very low during the first 4-5 cs and then rises sharply, or it rises gradually during the same period of time. This is indicative of vocal cord vibrations around a not yet completely adducted position, a breathy onset of the vowel, which will indeed lower Fo, ceteris paribus, (i.e. if the relative decrease in the Bernouilli effect caused by the non-adducted vocal cords is not countered by an increase in transglottal airflow).

The two Stockholm and Copenhagen speakers do not give rise to similar comments about variability, except that NRP and NT both produce slight rise-falls instead of clean falls in 'grå'. The different onsets with the two Skanian speakers (figures 55 and 56) are not, I think, to be seen as differences in segmental effects (which would be hard to motivate, anyway, given that we are dealing with [kʰ] in most cases). Rather, I think that the brief "reversed" movements at the onset of the word accents serve to highlight the significant rises and falls, respectively. The more "orderly" behaviour of the Stockholm and Malmö speakers vis-ã-vis the Bornholm speakers might reflect a difference between languages with and without distinctive (word) tones. Thus, Hombert (1978) suggests that there is an active process in tone languages which brings segmental effects in speech production within (time) limits where they do not interfere with the perception of the significant tonal events.

If we disregard, or visually compensate for, the variability exhibited by the Bornholm speakers, the following rather clear trends appear from figures 46-58. The Bornholm speakers compress the Fo pattern associated with the prosodic stress group under compression in time (until a compressibility maximum is reached, cf. below): in the polysyllables at the top of figures 46-52 the same Fo peak is reached at the end of the three words - it certainly does not lower. This is most easily appreciated with those speakers where a considerable shortening is found, from left to right, namely HC, CA, IB, and KP, where it is also clear that only the rising slope, not the fall, is affected by the compression: the wide valley becomes a sharp turning-point and/or the slope of the rise gets steeper, from left to right. Most speakers have a considerable initial fall (3-5 semitones) prior to the onset of the rise, which turning point occurs 15-20 cs after vowel onset and corresponds to the offset of the long vowel (cf. 'kanerne'). RK (figure 51) is an exception: the initial fall is very slight, rather brief (lasting around 8 cs), and consequently the turning point is located in the first half of the stressed vowel.

The monosyllables in utterance initial position retain the rise exhibited in the polysyllables (both qualitatively and quantitatively, i.e. its magnitude is not decreased, except slightly with HC and IB), but the initial fall is cut back! The, now isolated, rise is located within roughly the same margins on the frequency scale as in the polysyllables. Thus, the Bornholm speakers can be said to compress their Fo patterns

as far as possible. However, there are limits to the speed with which Fo changes can be brought about, and when the compressibility maximum is attained, the pattern is truncated, though not from the end but from the beginning, which means that the strategy for aligning segments and Fo patterns is altered. These procedures, both the compression and the change in strategy with ultra-short stress groups, bear testimony to preplanning and look-ahead in the "on-line" production of the seven Bornholm speakers.

'koldt' and 'grå' were both pronounced with phonetically long vowel sounds. So was 'vand' but not 'kat'. That the voiced stretch in 'kat' is too short for anything but level movements, modified by the context, would not disqualify the statements just made about Fo patterning in Bornholm, but I do not see why 'vand' could not have made more than the rather feeble attempts at a proper rise attested by everyone, except JT who reproduces the extensive pattern from 'koldt' (the final fall in JT's 'vand' is probably due to the succeeding obstruent in 'slukker', cf. the drastic effect of his initial aspirated stops; and whether the initial slight fall in 'vand' is a not completely truncated "full form", or a consequence of the preceding high Fo offset of 'koldt', is debatable). Position in the utterance cannot be made responsible for this 'undershoot' with six speakers, because extensive movements (fall-rises) are not otherwise confined to initial, or any other, position, as witnessed expressively by all of the preceding figures with the Bornholm speakers. Another possibility remains, namely that the less extensive movements in 'vand' (and maybe also in 'kat'?) are an expression of a downgrading in prominence. In Thorsen (1987) I hypothesized for Copenhagen Danish that variations in the extent of Fo movement within the stress group might reflect variations in prominence, though keeping within the realm of what may be termed 'neutral' stress. Applied to the present utterances it would mean that the adjective and the noun have a 'stronger versus weaker' prominence relation, something which I can apply meaningfully to my auditory impressions of HP, HC, RK, and KP. I do not mean to imply that the syntactic relation as such is necessarily the decisive factor, it may just as well be a semantic/pragmatic effect. Here is very clearly a domain for further research, i.e. the syntactic and semantic/pragmatic regulation and the manifestation of varying degrees of 'neutral' prominence in Danish.

The four Stockholm and Malmö speakers are much less ambiguous, though a straight comparison across all five frames is rendered impossible by the differences in word accent, indicated below each tracing. With BjH we may compare 'kamrorna' with 'kall' and 'grå' (Accent I) and note that the slow rise in 'kamrorna' turns steep, but equally extensive, in 'kall, grå'. EJ's 'kamrorna' defy an immediate comparison, because it comes from the utterance 'De tog fram kamrorna till nyår'. (The low final syllable of 'kamrorna' may be due to a somewhat less prominent accent: ER often produces double sentence accents in context free utterances which will make the second of three stressed words comparatively weaker, cf. Table II and section III.A.2 (b). It could also be that the low termination of 'kamrorna' is a means to set off the onset of the fall in the succeeding accent II ('nyår').) The two Accent II words behave slightly

differently with BjH and ER, but it does seem as if the stretching out over one (or two) post-tonic syllables of the rise in Accent I is not parallelled by a similar expansion of the fall in Accent II, which is executed within the stressed syllable. (This is confirmed by figure 26 and 27.) The behaviour of 'mjölk' and 'katt' calls for the same line of comments as 'vand' and 'kat' with the Bornholm speakers, cf. above.

MD and HD from Malmö produce extensive Fo falls in all the Accent I words, regardless of position, except that MD de-stressed 'kall', cf. figure 55. Since, further, HD produced 'kamrorna' with Accent II, there is not much left for a comparison of Accent I falls, but from MD it would seem as if Accent I falls are contained within the stressed syllable (this is confirmed by figure 30 and 31), and within those limits, set by the stressed syllable, the slope of the fall varies with duration, compare 'kam-' with '(m)jölk' and 'katt'. (Actually, the succeeding figures as well as figures 19-31 are more revealing about Fo patterns and alignment, where the Swedish and Bornholm speakers are concerned.)

NRP and NT (figures 57-58) confirm previous investigations (Thorsen 1980a, 1982, 1983a) that the fall-rise-fall is truncated from the end when it is pressed for time, and that the low turning point remains stable, relative to vowel onset, usually coinciding with a point in time which corresponds with a short vowel offset. What remains in monosyllabic stress groups with short vowel is the fall. Note that the more extensive falls, or rather the lack of a brief rise in the sonorant consonant of 'koldt, vand' and the long vowel of 'grå' (which onsets with a rise, due to the initial consonant), can be ascribed to the presence of stød in these segments.

(b) Evidence from the long utterances

On page 45 I noted that the rise during '(søs)ter hedder' was less steep than during '(Tór)bens' with HP in figure 1. The same can be said for HC, KP, and CA (figures 2, 6, 7). The utterances depicted in figures 19-25 will give further substantiation to a claim that (unmarked) Fo patterns follow a falling-rising configuration, with a time and frequency constant fall followed by a rise which is constant in magnitude, but whose slope, consequently, needs to be regulated according to its duration. These utterances apparently induced different speakers to different "readings" which in its turn gave rise to differences in Fo patterning, however. Only HP, HC, CA and four items by IB have the falling-rising Fo patterns, which I presume are the unmarked ones. (Partly because they are general in the larger part of the material, partly because that is how they strike my ear, whereas the various reversed versions by JT, RK, KR and two items by IB sound more insistant or lecturing.) I assume that the discontinuities between stressed vowel offset and post-tonic onset in 'Thórsen', 'rútebilen' observed with HP, and in 'Thórsen' with CA and IB are due to the [s] and [t^h], respectively. Compensation for this segmental effect (which is absent or a great deal weaker with HC)

would have made the onsets lower and thus the rises steeper, and, accordingly, we would have noted a rather straightforward inverse relation between rise-time and slope in these falling-rising Fo patterns. The same relation holds for IB's rising-falling patterns, i.e. the fall is steeper in the shorter post-tonic tails. It seems that a further regularity can be established at this point, namely that, for a given speaker, the fall and the rise cover approximately equal frequency intervals.

JT (figure 23) seems to have dodged the demand for pre-planning involved in the on-line production of HP, HC, CA, and IB, when he produced the five non-marginal stress groups with their falling stressed syllables succeeded by a skip up to the onset of high and roughly level post-tonics. RK replicates some of JT's stress groups (falling plus high level patterns) but also shares with KP some falling plus high-falling patterns, and KP in his turn has a couple of falling-rising patterns as well. I cannot ascertain that those high-falls that occur with KP (the second, third and fourth stress groups) and RK (the second stress group and possibly the third) are of equal magnitude with varying slopes. At this point I wish to call attention to the judgment, quoted on page 44, by a colleague who is thoroughly familiar with Bornholm, that HP, HC, CA, and IB sounded most natural and authentic and came closest to a spontaneous rendering of the material. Lack of spontaneity will probably make itself most markedly felt in these long utterances where, further, the degree of semantic predictability is next to nil, i.e. every lexical item is 'new', and thus I do not think that JT, RK and KP with these utterances invalidate a statement to the effect that, in Bornholm, falling-rising Fo patterns are preponderant in non-final stress groups which (1) are not subject to a focal sentence accent, and which (2) do immediately precede and (3) do not succeed such an accent (cf. section III.A.2(a) above). Final stress groups, stress groups under sentence accent, stress groups preceding and succeeding a sentence accent will be treated further below.

Stockholm and Malmö speakers (figures 26, 27, 30, 31) have entirely different strategies. The extensive Fo movements take place within the stressed syllables (Malmö: Accent I) or across the stressed and the first post-tonic syllable (Malmö: Accent II, Stockholm: Accent I and Accent II). Succeeding post-tonics take up and continue on the level where the stressed syllable or the first post-tonic lands them. Again, excepting stress groups (1) under and (2) succeeding a sentence accent, the execution of significant tonal events in both Malmö and Stockholm Swedish is restricted to one or a succession of two syllable(s), which limits the amount of pre-planning and look-ahead called for, although it does not obliterate it completely, cf. above (p. 118-119) about figures 52-56.

The Copenhagen speakers (figures 28 and 29) should be cleansed of a couple of segmental effects: the steep fall in NRP's '(Kō)foed og' is probably due to a combination of the initial

[f] which increases the onset value in the post-tonic and the stød in [ðʔ] which lowers the offset. The [s] in 'Thórsen' may have increased the onset of the post-tonic there as well. Similar remarks, though the effect is weaker, could be made for NT's '(Kø)foed og'. That apart, it appears that the post-tonic slope is constant, and so is the timing of both low (turning point) and high (onset of post-tonic fall). NT's penultimate stress group is an apparent exception.

(c) Long stress groups

The question was raised in connection with the arrangement of the material, whether word boundaries are associated with any particular Fo configuration in Bornholm. It has been shown already for Standard Danish (Thorsen 1980a, 1982, 1984), Standard Swedish (Bruce 1977) and Skanian (Touati 1987) that the relevant unit for the patterning of Fo is the prosodic stress group, that is: a succession of a stressed plus all following unstressed syllables (if any), irrespective of intervening word or syntactic boundaries (within the same intonation contour, i.e. within the same phrase, clause or sentence). That is not to say that a speaker has no means of signalling word boundaries, if he so desires, and one speaker in my 1980a investigation actually did so. I suggested then that this may be an optional characteristic of rather distinct, though not necessarily slow, speech. The cuttings presented in figures 59-69 present a long stress group (six and five post-tonics, respectively) and the next stressed syllable which constitutes a separate word in one case ('snart') and the word final syllable in the other ('keramík'). There is - as expected - no indication in the Fo traces of the difference in word boundary location, and if it were only for that, a couple of these figures would have sufficed as examples. I have chosen to include them all (except the two Copenhageners - long stress groups in Standard Danish being the subject of a separate paper, Thorsen 1984a), because they add a feature to what has been said about timing in Bornholm stress groups and they confirm neatly the Stockholm and Malmö material described above.

The seven Bornholm speakers behave uniformly where 'sílde-fiskerne må' is concerned, i.e. they all produce a falling-rising type pattern. However, the low turning point is not coincident with the offset of the stressed syllable. The fall continues, and the offset is thus both lowered and transposed 'to the right' where it coincides with the offset of the second post-tonic. The fricative onset and offset of this syllable ('-fis-') may be partly responsible, i.e. with sonorant consonants we might have found a broad valley (reminiscent of 'kanerne', cf. figures 46-52) with a minimum near the middle of this second post-tonic. Apparently, stress group patterning is even more flexible than the material already described has shown: The fall may also be expanded in time, when the stress group is long enough. But there must be more to it than mere length, because '(Tu)rísterne køber kera-' (with six post-tonics) does not exhibit the same trend, except for a slight

turning point delay with HC in figure 60. (Furthermore, speakers again form two groups: HP, HC, CA, and IB with fall-rises and JT, RK, and KP with rise-falls, cf. above. Like earlier cases, I will assume that JT's, RK's and KP's reversals are due to nuances in "reading" and I will not consider them any further here.) If environment is to be made responsible for the different alignment of segments and Fo in the two stress groups exhibited (by HP, HC, CA, IB) in figures 59-62, the reasoning would run as follows: '(Tu)rîsterne køber kera-' is the first stress group in the utterance, i.e. it is approached from below and the speaker's main concern must be to get high up in the range. HC, CA, and IB produce sentence intonation contours which do not reach the global maximum until the second stress group, i.e. they are still globally rising with the first one. Both facts might explain why the fall through the stressed syllable is not extended, or in other words, why the onset of the stress group rise is not delayed. The lower and later minimum in 'sîldefiskerne må' would then be ascribed to its position within the intonation contour (a) where the mild declination towards the final stress group has already begun and (b) where it is being approached from above (from the higher post-tonic in 'sîdste').

Stress group patterning is a great deal more variable than I had foreseen in Bornholm, both in terms of shaping and timing, and is clearly an area where further research is required. But certain mechanisms, which seem to be specific to Bornholm as against Standard Copenhagen, Malmö and Stockholm Swedish, appear clearly enough, namely the look-ahead demanding stretching and squeezing of Fo patterns associated with prosodic stress groups in unison with the durational specifications.

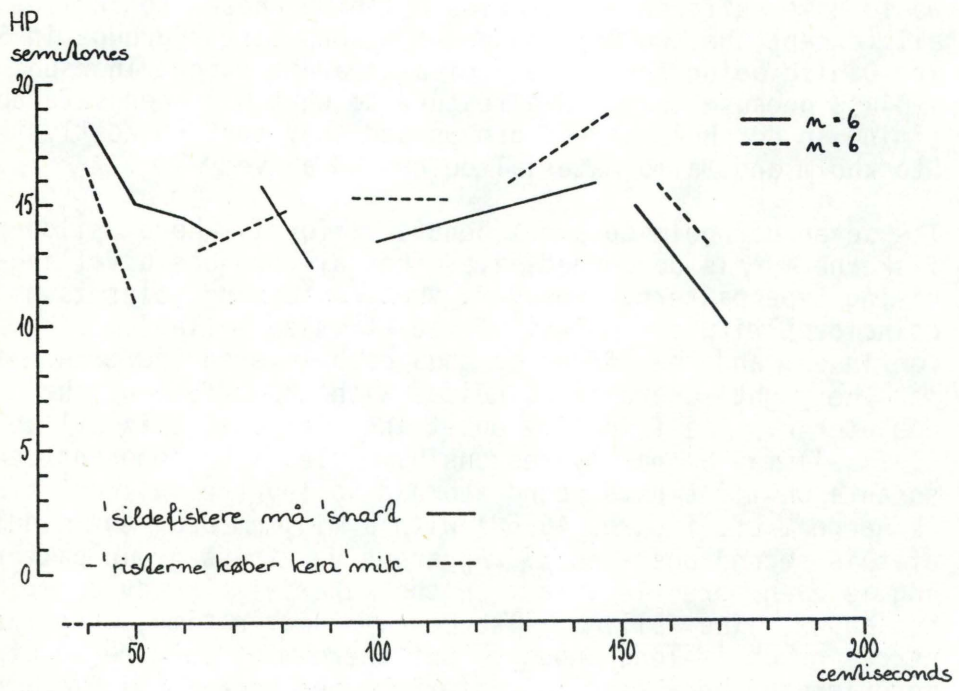


Figure 59

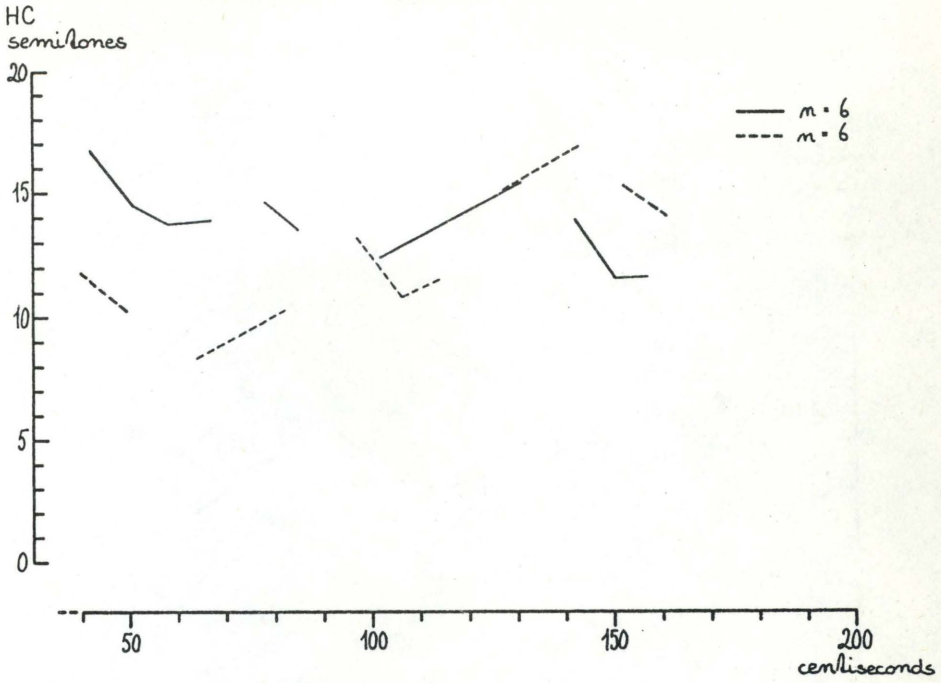


Figure 60

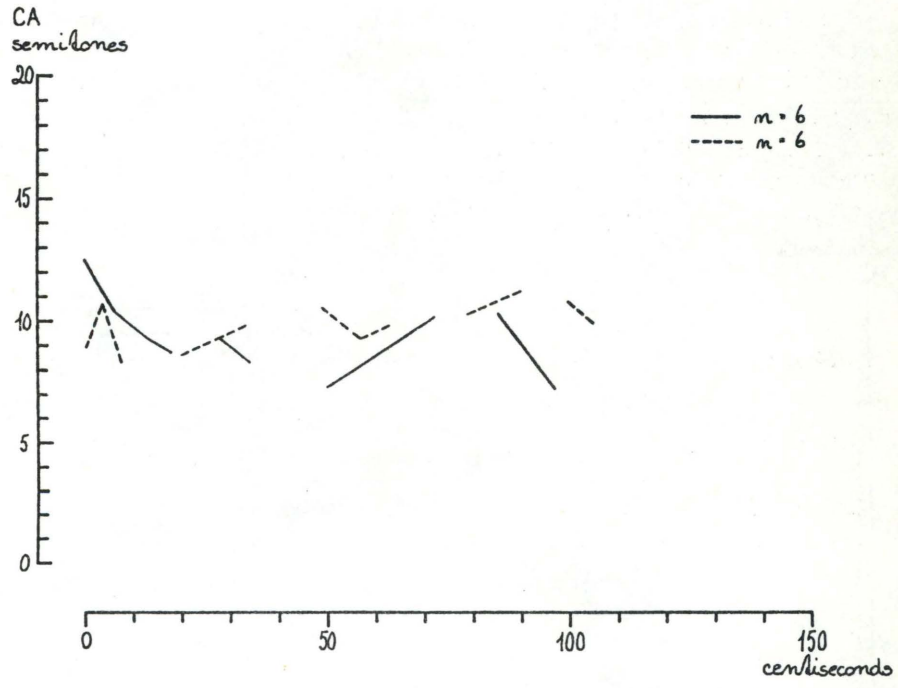


Figure 61

Figures 59 - 69

Average fundamental frequency tracings (logarithmic display) of two long stress groups plus the next stressed syllable by seven Bornholm, two Stockholm and two Malmö speakers. See further the legend to figures 1-7 and 10-13.

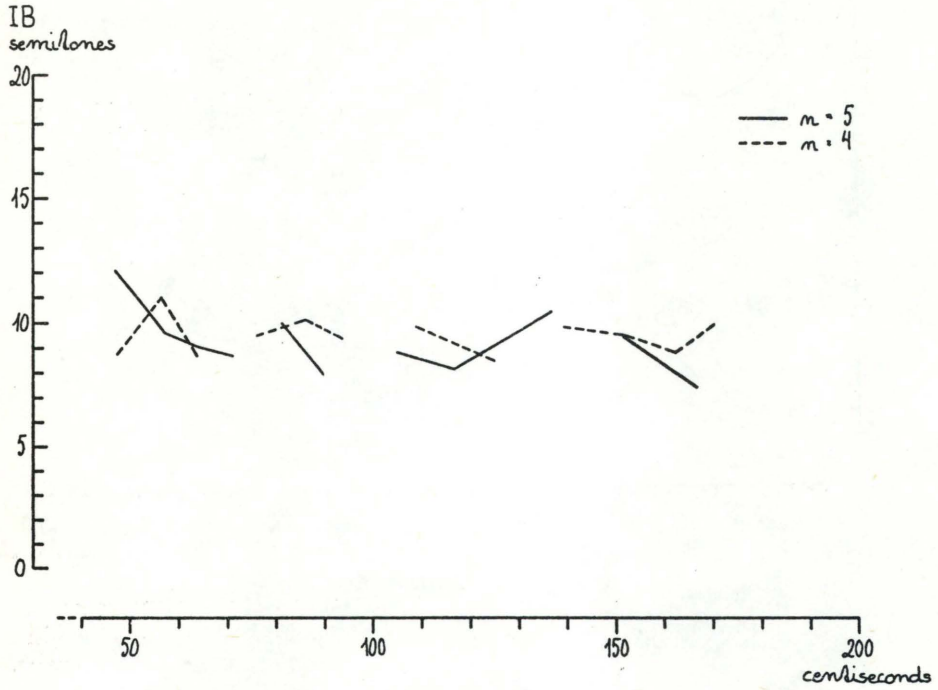


Figure 62

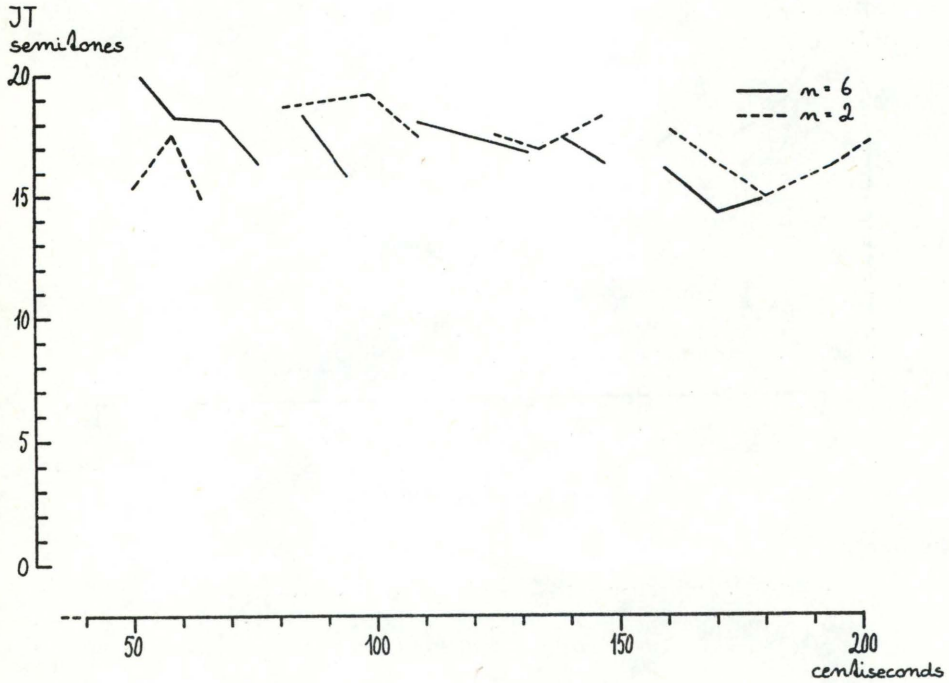


Figure 63

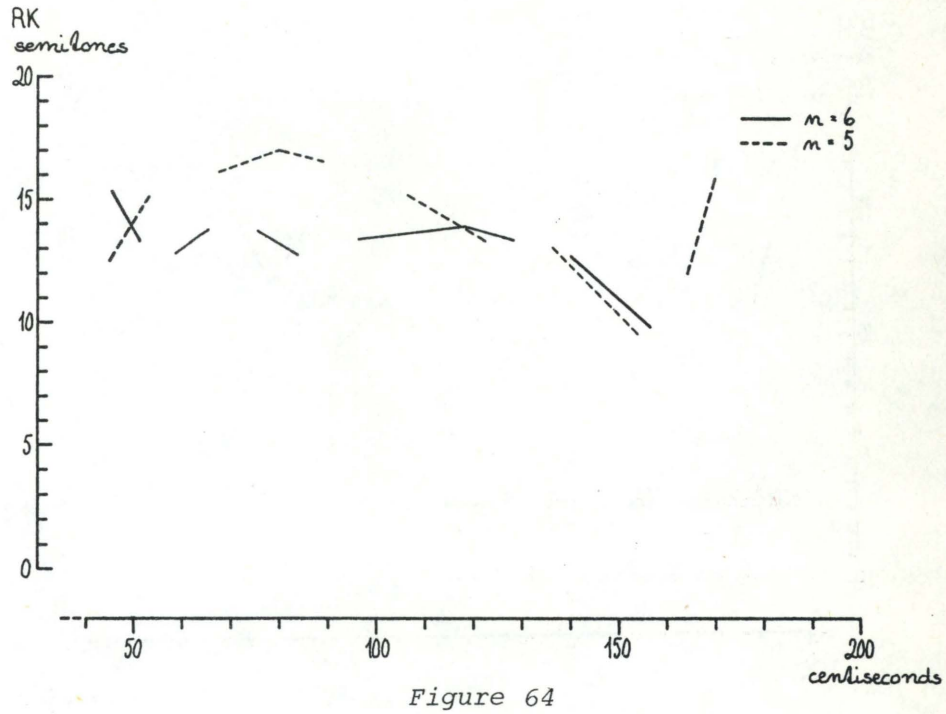


Figure 64

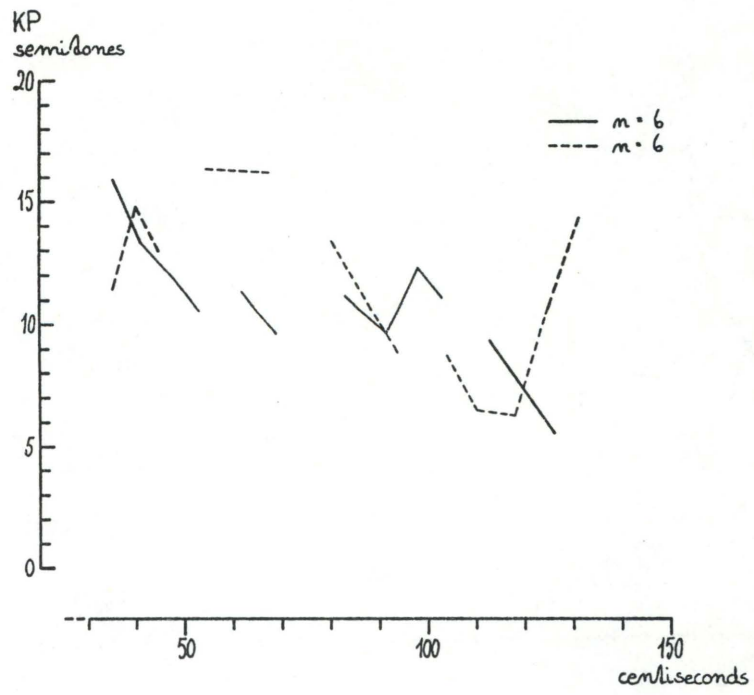


Figure 65

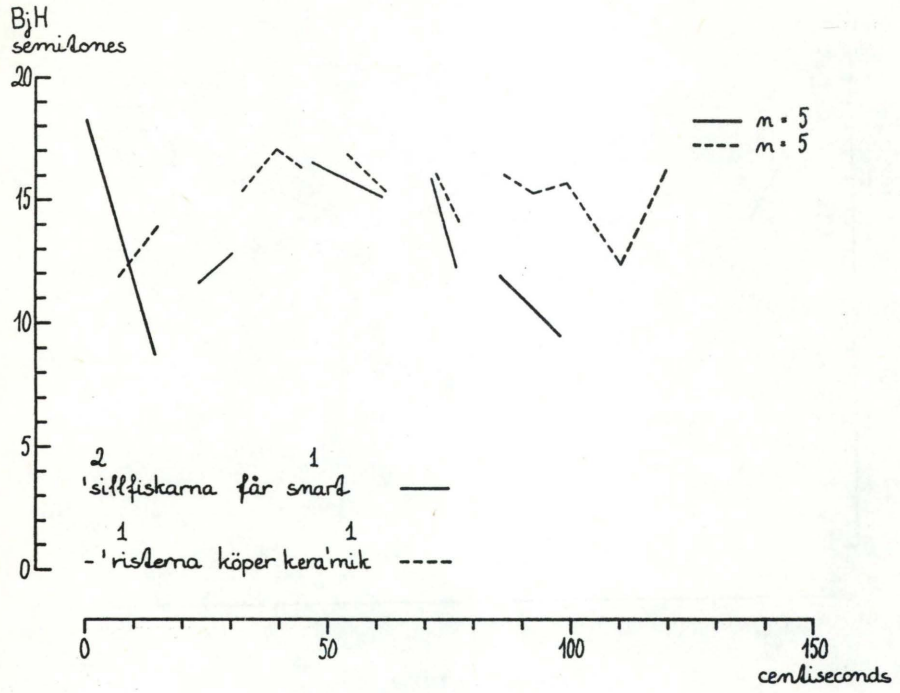


Figure 66

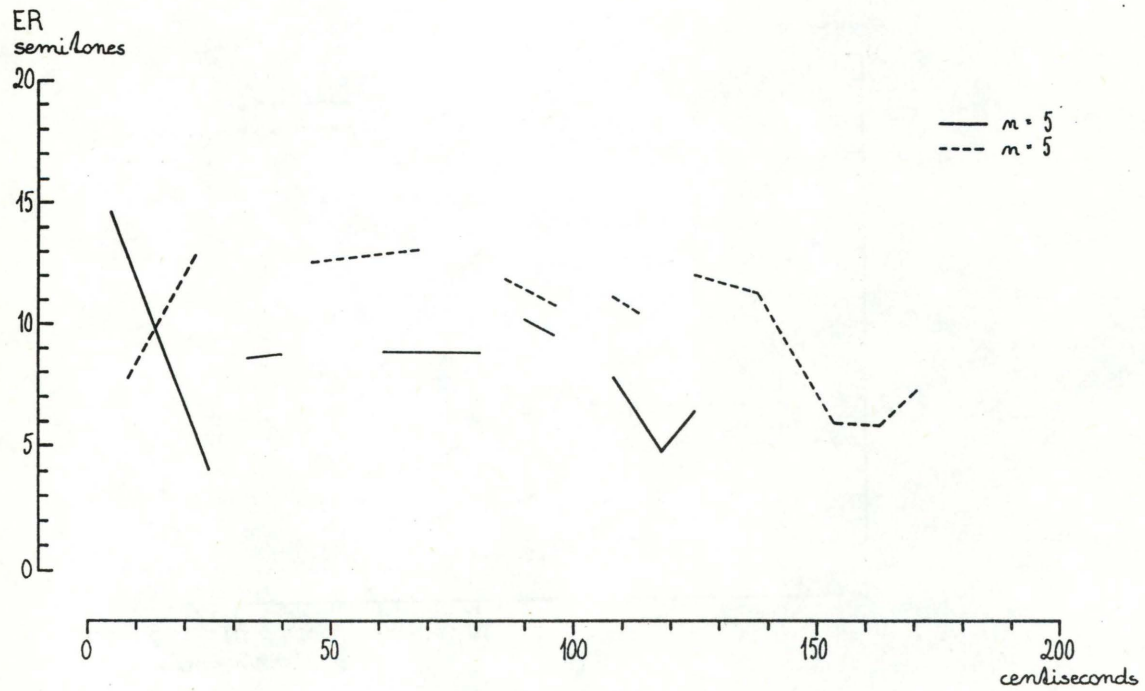


Figure 67

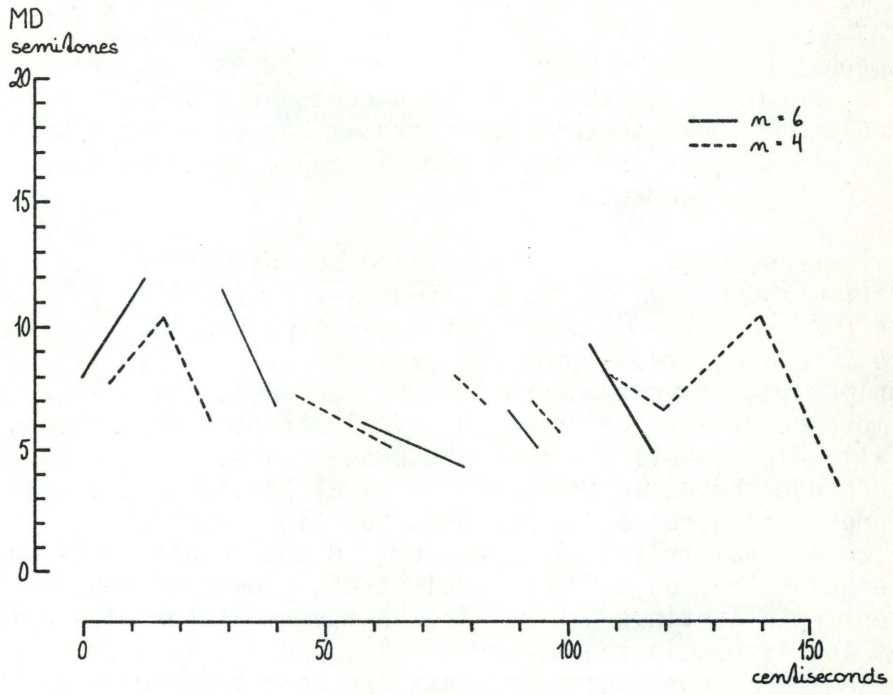


Figure 68

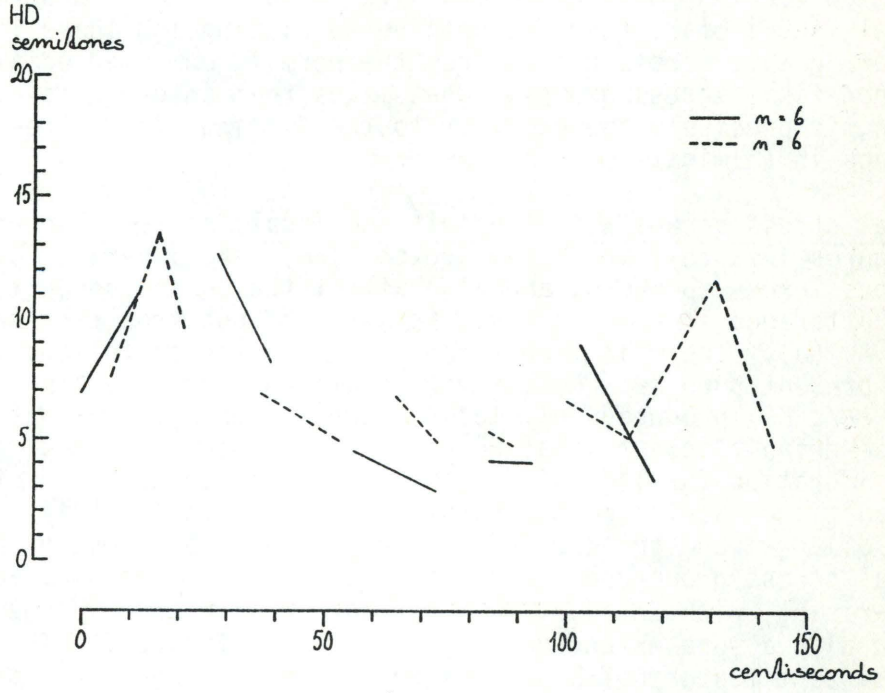


Figure 69

2. Stress groups in final position and in connection with sentence accents

The focus here is the qualitative change in stress group patterning, i.e. the center of interest is the Bornholm speakers. (Copenhagen speakers have no sentence accents, and the manifestation of the scattered focal accents in Malmö as well as default and focal accents in Stockholm has been dealt with above and did not show any change in basic patterning or alignment with the segments.)

Final stress groups without sentence accent on terminal declarative intonation contours (figures 1-7, full line) invert the general, unmarked falling-rising (or low-high) pattern into a continuous fall (or a high-fall). This is exceptionless with four speakers (HP, HC, CA, JT). With RK it would be more correct to describe the final stress group pattern as a fall which levels out over the post-tonics. KP and IB do not change the basic fall-rise in final position in trisyllabic 'Sváneke' (figures 3 and 6, top), but tag a fall on to it (in the word final syllable). However, in the remainder of the utterances they do produce final stress groups without sentence accent with continuously falling Fo movements (or with a fall plus low level, in the manner of RK), and I will assume that falling final non-accented stress groups are the general feature.

Only two speakers, HC and IB, produced questions with non-terminal intonation contours, i.e. with a local final rise. This rise is performed in the post-tonics (in 'Sváneke'), i.e. the low turning point coincides with the offset of the stressed vowel, and in fact there is nothing to distinguish these final interrogative stress groups from the normal, unmarked edition of non-final stress groups. What makes them interrogative, then, is precisely the contrast to the falling final stress groups in terminal declaratives.

Final stress groups with (default and focal) sentence accent (figures 1-7, thin and heavy broken line) take a variety of shapes across speakers, and also affect the preceding part of the utterance in various ways, as was apparent from section III.A.2(a). The main trends can be summarized as follows for the present purpose: Note first of all that three speakers (CA, RK, KP) produced only focal accents finally, and that those default accents that HC produced have been left out of consideration for lack of uniformity, so the comparison between default and focal accents rests upon three speakers only (HP, IB, JT). - One speaker (KP) did not change the shape of his final stress group under focal accent either, it remains falling-rising, with an added fall for terminality, and in one case also a more extensive Fo movement, cf. figure 6. The consistent feature of his final SA is the tilting of the preceding global contour, but that is of no concern here.
CA (figure 7) did alter the shape of his final stress groups into continuously falling ones, but shares with KP the lack of any other consistent signal for final focal accent apart

from the tilting of the preceding contour. HC (figure 2) presents a border line case between KP and CA and the remaining speakers. HC produces final focal accents which are rising-falling, though the rise is modest. Modest is also the twisting down of the tail end of the preceding sequence of unstressed syllables, two facts which may well be related (cf. below), and she also tilts the preceding contour. HP, IB, JT and RK (figures 1, 3, 4, 5) produced explicit rising-falling final accents (in contradistinction to their no-accent stress groups), where the fall is of greater extent than the rise, however. Simultaneously they produce very explicit and extensive lowering of the tail of the preceding stress group pattern. This lowering tends to be greater in the focal than in the default accent case with those three speakers who produced consistent default accents (HP, IB and JT), supporting the contention that default and focal accents are different both to their function and their phonetic shape. The high turning point is generally coincident with the offset of the stressed vowel (this fact is not apparent in the figures). In section III.A.2(a) I accounted for this modification of the preceding stress group as a way to high-light, render prominent, the final accent, and I see that as yet another confirmation of the plasticity of speech production. Of course, this phenomenon is also inconceivable without look-ahead and pre-planning in the execution of tonal events, because the shape of the pre-accentual stress group is sensitive to the nature of the upcoming event: if the final accent is of the high-fall type, no modification of the preceding unstressed syllables is required, they will automatically terminate higher than the onset of the final fall; but if the upcoming accent is of the rising-falling type, the preceding unstressed syllables will change the last part of their rising course into a falling one, so as to end up beneath the low onset of the accentual rise. It is also apparent that one and the same speaker may employ both strategies: HP produced default accents in the long utterance (figure 19) and in the question (which he pronounced with a declarative intonation - figure 33). These accents are of the high-fall type, and accordingly there is no modification of the preceding stress group pattern, which is cleanly rising.

Medial (focal) sentence accents (figures 1-7, mid - dotted line) appear in two shapes: HP, HC and KP have high-falling accents preceded by an unmodified low-high stress group pattern. IB, JT and RK have inverted, i.e. rising-falling, accents preceded by a stress group whose tail is twisted downwards, just like medial stress groups before final rising-falling accents. (With IB the preceding stress group pattern is completely deleted, actually, in a manner which is reminiscent of Copenhagen Danish stress groups surrounding an emphasis for contrast.) CA's signalling of the medial accent is very inconspicuous, cf. also p. 48. The high turning point in rising-falling medial accents generally coincides with the stressed vowel offset (not apparent in the figures). Since neutral final stress group patterns generally are high-falling, no qualitative change is apparent when they are preceded by a focal accent, but the final fall is lowered and/or diminished so as to smoothly continue the fall initiated in the preceding accented item.

Initial (focal) accents (figures 1-7, dotted-broken lines) come out with inverted, i.e. rising-falling Fo patterns, with HP, HC and IB, except that HC's 'Kamma' is (low)falling-(high) rising. With the remaining speakers it is the suppression of succeeding Fo patterns which is the most conspicuous feature.

To summarize all of this section (p. 103 ff): The production of stress group patterns in Bornholm stands out by its variability and great flexibility. This is possible because Bornholm does not have distinctive tonal word accents, as opposed to Malmö and Stockholm Swedish. The same fact probably also accounts for the difference in the domain over which compression of tonal patterns takes place: it encompasses all of the prosodic stress group in Bornholm, but only extends over the stressed, or the stressed and first post-tonic, syllable in Malmö and Stockholm (which is what motivates the designations "extensive" versus "slight" compressions in the schematic summary in section IV). It may well also be this latter feature which, more than anything else, makes Bornholm Danish so easily identifiable auditorily.

D. FINAL LENGTHENING

Due to the rather parenthetical nature of this part of the investigation, the present section will be restricted to a mere presentation of the facts. For a thorough treatment of segment duration as a function of context, including references to the existing literature, the reader is referred to Lindblom (1978) and Fischer-Jørgensen (1982). However, let me briefly summarize what is known about Stockholm, Skanian and Copenhagen. Final lengthening as such is an uncontested fact of Stockholm Swedish, although the explanation for it is debated, cf. Lyberg (1977) and Bannert (1982). The order of magnitude varies with the composition of the word, the lengthening of the vowel of monosyllables being greater than the first stressed vowel of di- and trisyllables, centering around 4-5 cs. (To my knowledge, there are no published data on the post-tonic syllables in polysyllabic words in Swedish.) Touati (1987) bases his observation that final lengthening is absent in Skanian upon measurements of word final stressed vowels, but adds a reservation (p. 162) that unaccented syllables might appear lengthened finally. Fischer-Jørgensen (1982) obtained values between 1.5 cs and 3.5 cs for short and long stressed vowels, respectively, in Danish, basing her observations upon measurement of a large number of speakers from a variety of regional language and dialect backgrounds, among them one Copenhagener, NRP.

I have measured each segment in 'Kamma', excluding the closure of the aspirated stop, though, which cannot be delimited in utterance initial position. I have measured groups of segments in '-rĭ/st/erne', as indicated by the slants. There are two major segmentation problems: intervocalic /r/ in 'turĭsterne', whether it be a uvular approximant/obstruent (as in Copenhagen, Bornholm and Malmö) or an apical continuant (as in Stockholm),

and then, of course, the utterance final vowels. The /r/-onset was determined where the intensity curves begin to drop from the preceding vowel. A few shady cases were left out of consideration. The final vowels are more cumbersome. They may terminate in strong or in weak creaky voice; in weak breathy voice or in weak unvoiced aspiration. The segmentation which offers the best uniformity across speakers and utterances is a vowel offset coinciding with the point in time where the high-pass filtered intensity curve reaches zero, which is accordingly the criterion adopted here. This corresponds physiologically to the point in time where the vibratory pattern of the vocal cords produces a source function with little energy in the upper part of the spectrum and where any energy below 500 Hz, which might be produced by weak creaky voice or by 'edge vibrations', is disregarded. An objection to the effect that this cuts back precisely that phase which may constitute the final lengthening is at least partially muted by the fact that the same procedure has been employed across all speakers and regional languages, but it did indeed lead to different results for the various groups. Correspondingly, the final vowel in initial words was offset at the point in time where the intensity of the noise of the succeeding fricative /f, s/ rises sharply ('Kámma stámmer fra...' / 'Turísterne fordőbler ...'/ 'Turisterna fördubblar...'), or where the closure of succeeding /k/ has been formed ('Kamma kommer från ...'), i.e. where the intensity reaches zero.

The results are presented in table V, where the difference, in centiseconds, of the total duration of the (part of the) word in final minus initial position is given, with footnotes about the distribution of the lengthening in those cases where it is both statistically significant and considerable. Note that there are a number of negative values, i.e. instances where the initial item was longer than the final item, ceteris paribus.

There are scattered examples of significant, though slight, lengthenings finally in Bornholm, but there are more cases where the initial item was considerably and significantly longer than the final one, a difference which is either distributed all over the stress group (IB), or mainly due to the final vowel (JT, RK). If anything, finality is signalled in Bornholm through an accelerated speech tempo, and there are no grounds for positing a feature 'final lengthening' in Bornholm Danish.

Conversely in Stockholm where the positive differences in duration are fairly considerable and highly significant. Particularly with ER, which may be due to her style of speech, cf. above about her phrase-final Fo rises. Both speakers produced default sentence accents on final 'turísterna' which had to be omitted here. The lengthening is distributed approximately evenly over all the segments with BjH, whereas it affects the final vowel most with ER.

Table V

Differences of duration, in centiseconds, of (parts of) words in utterance final minus initial position, under various conditions of prominence: no sentence accent (Kámma, (tu)rísterne), reduced prominence due to a sentence accent located elsewhere (K(á)mma), sentence accent (invited by the context, K+ámma). Many blanks in the table are due to prominence conditions not being met in one or both positions. Seven Bornholm speakers, two Stockholm speakers, two Malmö speakers, and two Copenhageners. Differences that are statistically significant (student's one-tailed t-test) are indicated with one, two, or three stars, corresponding to levels of probability of 0.05, 0.005, and 0.0005, respectively.

		Kámma	K(á)mma	K+ámma	(tu)rísterne
HP			-0.8	-1.9	-1.3
HC	*BORN-HOLM*			2.3*	1.8
CA				1.3	-2.5*
IB				-8.6** [1]	-6.3*[1]
JT		-11.3***[6]		-7.5***[6]	-0.9
RK		-7.6***[6]			-3.0
KP		3.2*	3.2**	2.8	1.3
BjH	*STOCK-HOLM*		5.5***[8]	4.8***[8]	
ER			12.0***[2]	9.7***[2]	
MD	*MAL-MÖ*	-0.5			-2.0*
HD		7.0***[8]			9.8**[7]
NRP	*COPEN-HAGEN*	6.2***[5]			9.0[3]
NT		4.5***[4]			5.7[3]

1) all segments are shortened to approximately the same degree
2) the final vowel is lengthened most
3) the posttonic segments carry the major part of the lengthening; there are only three items behind the averages, but there was no overlapping of measurements in the two positions
4) the lengthening is due to the stressed vowel
5) [m] is lengthened most
6) the posttonic vowel is shortened most
7) the posttonic segments carry the major part of the lengthening.
8) all segments are lengthened to approximately the same degree

One Malmö speaker, MD, teams up with the Bornholm speakers, whereas HD has considerable and significant lengthenings finally, which attack either all of the segments, or mainly the post-tonic ones. Note that MD was also the one who never produced any sentence accents, be they default or focal. One is left to wonder whether these are general prosodic options in Malmö or whether either MD or HD forms an exception to an otherwise uniform prosodic system.

Eli Fischer-Jørgensen has very kindly lent me her raw data on NRP. In the comparable part of her material, namely disyllables of the /'CVCə/ type, the final words are longer than the non-final ones by between 10.4 and 12.2 cs, which corresponds to around 30%, with the word final vowel carrying most of this difference (being lengthened between 4.2 and 7.8 cs), the stressed vowel coming second (being lengthened between 1.2 and 3.4 cs). These values are somewhat higher than what I have obtained (which may, at least partly, be due to different segmentation criteria).

I have been very surprised to find these high values with the Copenhagen speakers. I would have been less surprised if we had come out with small and insignificant final lengthenings, because it has been my (auditory) impression that this is one (among many) point(s) where Copenhagen Danish and Stockholm Swedish sound decidedly different. It may well be that I have suffered from an illusion or a misconception and have associated the final lengthening of Stockholm with the final default accent, which Copenhagen lacks and which may render the final lengthening less prominent perceptually.

IV. SUMMARY

The results have been compared across regions and discussed in each section above. The schema below is only intended to facilitate a direct comparison of the parameters investigated (plus one: word tones).

	COPENHAGEN	MALMÖ	BORNHOLM	STOCKHOLM
SENTENCE INTONATION IS SIGNALLED	globally	globally	locally	locally
DEFAULT SENTENCE ACCENT	no	no	optional	obligatory
FOCAL SENTENCE ACCENT	no	optional (not frequent)	optional (frequent)	obligatory
FINAL LENGTHENING	yes	optional?	no	yes
COMPRESSION OR TRUNCATION	truncation	slight compression	extensive compression	slight compression
WORD TONES OR STØD	yes	yes	no	yes

It is immediately apparent that the prosodic system of Bornholm is as opposed to Copenhagen as can be. The two do not share one single prosodic feature. At the level of the sentence or utterance, we may actually posit a pairwise closer similarity between Copenhagen and Malmö, and between Bornholm and Stockholm, respectively, keeping in mind that though focal sentence accents are optional in both Malmö and Bornholm, they are considerably more frequent in Bornholm.

There are grounds for some speculation here. At the outset, one might have thought that (partial) compression of tonal patterns was a consequence of the presence of phonologically distinct tonal word accents; that the discrimination and identification of significant tonal events stipulated a full tonal development, regardless of the brevity of segmental material to carry it. But then the compression found in Bornholm would not be justified, unless, of course, that is what is left, the last trace, of a long forgotten word tone opposition. This is rather far-fetched, however: It is generally assumed that most of the Scandinavian area developed a prosodic distinction at the word level some time during the first half of the millennium, cf. Fischer-Jørgensen (1987) and Gårding (1977), but it is uncertain whether those areas at the periphery (southern Jutland, the southern Danish islands), which today have no tonal and no stød distinction, ever had one, or whether they are true relic areas. Secondly, it is equally possible for the tonal distinction to have developed from a stød one, as vice versa. Thus, the compressed tonal patterns in Bornholm can only be historically motivated IF tonal patterns developed first (and then fed the development into stød in some areas), and IF these patterns originally developed in all of Scandinavia, including the fringes. - However, there is a much more down-to-earth and concrete reason to disbelieve any imprint from a former tonal word accent distinction in Bornholm, namely what may be termed the expansion beyond the limits of the word boundary if more unstressed syllables succeed. That is, in Malmö and Stockholm the tonal movements are not expanded beyond the first post-tonic syllable in the stress group, and post-tonics after that run level (high or low, where ever the stressed syllable or the first post-tonic takes them). In Bornholm the (predominantly rising) movements are stretched out over the whole stress group, irrespective of its length. This probably has to go down as a peculiarity of Bornholm prosody, one which gives Bornholm its very characteristic "sound".

The final lengthening is also distributed in a curious manner: Bornholm and Stockholm sentence prosody being so similar, I would have expected them to share this feature (but note that my prejudice would also have denied Copenhagen any appreciable final lengthening). This is a matter that deserves more looking into, but if the results withstand further challenges, then final lengthening is clearly a completely independent parameter and in no way principally linked to the occurrence of extensive tonal movements (in the shape of final default sentence accents), as also maintained by Bannert (1982), nor is it a "universal" feature.

The distribution of sentence accents across the four regions and their realization might motivate a speculation that the manifestation of sentence intonation is linked to the presence (and manifestation) of final default sentence accents. Not in any insoluble, one-to-one relation, though, because local sentence intonation appears also in utterances produced without final default accents (in Bornholm). But it is not unlikely that globally distributed sentence intonation, i.e. a rather gentle overall slope, would be masked perceptually by the extensive final movements pertaining to the default accent, so sentence intonation signals need to be contained within or tagged on to the tonal movement of the default accent. This strategy is generalized, it becomes the way to render sentence intonation, also in the occasional absence of a default accent. The hypothesis would state that global intonation precludes final default accents (which leaves the possibility of having local sentence intonation without default accents).

V. NOTES

(1) In the following, 'Standard Danish' and 'Standard Swedish' will mostly be abbreviated 'Danish' and 'Swedish', respectively.

(2) References will be given in the results and discussion sections.

(3) Stød may be described as a kind of creaky voice which can occur in certain syllable structures in Danish. Although its presence is largely morphologically and phonologically determined it has a distinctive function in surface phonological forms. Presence versus absence of stød corresponds roughly to the Swedish tonal word accent I versus II distinction. See further Basbøll (1985) and Gårding (1977).

(4) BjH and ER both protested that the original version 'De tog kamrorna fram till nyår.' was ill-formed, so 'De tog fram kamrorna till nyår.' was added to the six cards, and both versions were read by the four (Swedish and Skanian) speakers.

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REFERENCES

Areskoug, H. 1957: *Studier över sydöstskånska folkmål*, (Gleerup, Lund)

Bannert, R. 1982: "An Fo-dependent model for segment durations?", *Reports from the Institute of Linguistics, Uppsala University 8*, p. 59-80

Bannert, R. 1985: "Fokus, Kontrast, und Phrasenintonation im Deutschen", *Zeitschrift für Dialektologie und Linguistik 52*, p. 289-305

Basbøll, H. 1985: "Stød in Modern Danish", *Folia Linguistica 19*, p. 1-50

Bruce, G. 1977: "Swedish word accents in sentence perspective", *Travaux de l'Institut de Linguistique de Lund 12*, p. 1-155

Bruce, G. 1979: "Word prosody and sentence prosody in Swedish", *Proc. 9th Int. Congr. Phon. Sc., vol. II* (Copenhagen), p. 388-394

Bruce, G. 1981: "Tonal and temporal interplay", in: *Nordic Prosody II*, (ed.: Fretheim, T.), Trondheim, p. 63-74

Bruce, G. 1982: "Developing the Swedish intonation model", *Working Papers 22, Dept. of Linguistics, Lund University*, p. 51-116

Bruce, G. and Gårding, E. 1978: "A prosodic typology for Swedish dialects", in: *Nordic Prosody* (eds.: Gårding, E., Bruce, G., and Bannert, R.), Dept. of Linguistics, Lund University, p. 219-228

Fischer-Jørgensen, E. 1982: "Segment duration in Danish words in dependency of higher level phonological units", *Ann. Rep. Inst. Phon., Univ. Copenhagen 16*, p. 137-189

Gårding, E. 1977: *The Scandinavian Word Accents, Travaux de l'Institut de Linguistique de Lund 11*, p. 1-116

Gårding, E. 1978: Satsintonation i svenska, *Bidrag till Elfte sammenkomst för svenskans beskrivning*

Gårding, E. 1986: "How many intonation models are there in Lund?", *Reports from Uppsala University, Linguistics Department*

Gårding, E., Bannert, R., Bredvad-Jensen, A.-C., Bruce, G. and Nauclér, K. 1974: "Talar skåningar svenska?", *Svenskans Beskrivning 8*, p. 107-117

Gårding, E. and Lindblad, P. 1973: "Constancy and variation in Swedish word accent patterns", *Working Papers 7, Lund University*, p. 36-110

Hombert, J.-M. 1978: "Consonant types, vowel quality, and tone", in: *Tone - A Linguistic Survey* (ed.: Fromkin, V.), Academic Press, New York, p. 77-111

Liberman, M. Y. and Pierrehumbert, J. 1984: "Intonational invariance under changes in pitch range and length", in: *Language Sound Structure*, (eds.: Aronoff, M. and Oehrle, R. T.), M.I.T. Press, p. 157-233

Lindblom, B. 1978: "Final lengthening in speech and music", in: *Nordic Prosody I* (eds.: Gårding, E., Bruce, G. and Bannert, R.), Dept. of Linguistics, Lund University, p. 85-101

Lyberg, B. 1977: "Some observations on the timing of Swedish utterances", *J. Phonetics 5*, p. 49-59

Lyberg, B. 1979: "Final lengthening - partly a consequence of restrictions on the speed of fundamental frequency change?", *J. Phonetics 7*, p. 187-196

Lyberg, B. 1981: "Some observations on the vowel duration and the fundamental frequency contour in Swedish utterances", *J. Phonetics 9*, p. 261-272

Pierrehumbert, J. 1980: *The Phonology and Phonetics of English Intonation*, M.I.T. Doctoral Dissertation

Pierrehumbert, J. 1983: "Linguistic units for Fo synthesis", *Abstracts, 10th Int. Congr. Ph. Sc.*, Foris Publications, Dordrecht, p. 137-144

Strangert, E. 1983: "Temporal characteristics of rhythmic units in Swedish", in: *Nordic Prosody III* (eds.: Elert, C.-C., Johansson, I., and Strangert, E.), Almqvist & Wiksell, Stockholm, p. 201-213

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

Thorsen, N. 1980a: "Word boundaries and Fo patterns in Advanced Standard Copenhagen Danish", *Phonetica 37*, p. 121-133

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

Thorsen, N. 1980c: "A study of the perception of sentence intonation - Evidence from Danish", *J. Acoust. Soc. Am. 67*, p. 1014-1030

Thorsen, N. 1982: "On the variability in Fo patterning and the function of Fo timing in languages where pitch cues stress", *Phonetica 39*, p. 302-316

Thorsen, N. 1983: "Standard Danish sentence intonation - Phonetic data and their representation", *Folia Linguistica 17*, p. 187-220

Thorsen, N. 1983a: "The tonal manifestation of Danish words containing assimilated or deleted schwa", in: *Nordic Prosody III* (eds.: Elert, C.-C., Johansson, I., and Strangert, E.), Almqvist & Wiksell, Stockholm, p. 215-230

Thorsen, N. 1984: "Fo timing in Danish word perception", *Phonetica 41*, p. 17-30

Thorsen, N. 1984a: "Variability and invariance in Danish stress group patterns", *Phonetica 41*, p. 88-102

Thorsen, N. 1985: "Intonation and text in Standard Danish", *J. Acoust. Soc. Am. 77*, p. 1205-1216

Thorsen, N. 1986a: "Sentence intonation in textual context - Supplementary data", *J. Acoust. Soc. Am. 80*, p. 1041-1047

Thorsen, N. 1986b: "Intonation and text in Standard Danish - with special reference to the abstract representation of intonation", in: *Phonologica 1984* (eds.: Dressler, W.U., Luschützky, H.C., Pfeiffer, O.E., and Rennison, J.), Cambridge University Press, p. 301-309

Thorsen, N. 1987: "Text and intonation - a case study", in: *Nordic Prosody IV* (eds.: Gregersen, K. and Basbøll, H.), Odense University Press, p. 71-79

Touati, P. 1987: "Structures prosodiques du suédois et du français", *Travaux de l'Inst. de Linguistique de Lund 21*, Lund University Press.

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A DANISH TEXT-TO-SPEECH SYSTEM USING A TEXT NORMALIZER BASED ON MORPH ANALYSIS*

BJÖRN GRANSTRÖM**, PETER MOLBÆK HANSEN, AND NINA GRØNNUM THORSEN

A Nordic cooperative project has been started to develop a text-to-speech device for the Nordic languages. The development is based on the system originally created in Stockholm. Language specific features have necessitated modifications of the original structure. For Danish, this primarily involves the inclusion of a morph based "text normalizing component". This paper presents the construction and function of the system and also discusses some preliminary use of the device.

I. INTRODUCTION

Speech synthesis has been a major line of research in our two departments for several decades. In Sweden, this effort has resulted in a multi-lingual text-to-speech system (ref. 1), commercially available through Infovox AB. A joint effort within the project "A Nordic text-to-speech system", financed by The Nordic Committee on Disability, is aimed at making this device available to the handicapped in the Nordic countries.

Although the Nordic languages are mutually intelligible, Danish poses some special problems for a text-to-speech system because the relation between the standard orthography and pronunciation is rather complicated. To tackle this we have included a unique

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component in the system that transforms words into an idealized normalized orthography. This is accomplished through a morphological analysis based on a set of moderately large morph lexica. With a limited set of rules the result is transformed to a phonetic transcription, including stress.

In a phonetic rules component, special care has been taken to realize the prosodic structure of Danish which differs considerably from standard Swedish or Norwegian. There are also many other differences in structure such as the ample use of "stød", a kind of creaky voice unknown in the other Nordic languages but which corresponds roughly to the tonal word accent I in Swedish and Norwegian.

II. MORPHOLOGICAL ANALYSIS AND NORMALIZATION

The inclusion of a normalization component (NC) is a deviation from the general philosophy of the KTH system which is rule based. The work done by the NC corresponds with the work performed by certain early rules in the rule components for the other languages. There was a practical and a theoretical motivation behind the establishment at the Institute of Phonetics, University of Copenhagen (IPUC) of a lexicon based NC for Danish. The practical reason was that Danish orthography corresponds very badly with pronunciation and that the number of rules in a rule based conversion system, and also the degree of arbitrariness of most of such rules, would have been prohibitive. For a more detailed description of the peculiarities of Danish orthography, see (ref. 2). The theoretical reason was that the use of a morph lexicon should reflect more closely the human process of reading, since we generally know the morphemes of our native language and only feel the necessity of relying on some sort of mental rule system when occasionally we come across a hitherto unknown word in a text. The NC does two things: it supplies the correct morphological boundaries, and it normalizes the spelling of individual morphemes. A few examples illustrate this: A word like *dal* ('valley') is pronounced with a long vowel, whereas *tal* ('number') is pronounced with a short vowel. The NC will identify these words correctly and output them as DAL and TALH, respectively, thus assigning to them a notation which is consistent - but not identical - with a phonetic transcription. The symbol H represents an abstract consonant phoneme which will prevent the vowel from being lengthened and the consonant L from receiving the stød. A word like *kvindeemancipationen* ('the emancipation of women') represents a more complex case: It is analysed by the NC as consisting of the morpheme sequence KVIND (a native root), + E (a native suffix) + E (a latin prefix) + MAN + CIP (latin roots) + AT + ION (latin suffixes) + EN (a native ending), and it is output as KVIND#mEO#iE#fMANCIPATION#pEON. The symbol sequences #m, #i, #f, and #p represent various morphological boundaries with different phonological effects. No boundaries are inserted between MAN and CIP nor between AT and ION because such boundaries would not supply any information

relevant to pronunciation. The symbol sequence E0 represents the vowel schwa. A word like *hund* ('dog') is output as HU6ND. The sequence U6 represents a particular, abstract phoneme which resists an otherwise general phonological rule of Danish which lowers high vowels before homosyllabic nasals.

Thus, the inventory of distinct symbols which may be output from the NC is considerably larger than both the number of letters in the alphabet and the number of phonemes needed to represent Danish speech. The problems of integrating the NC as such into the system have been few and small, since its output, i.e. the input to the rule system, is of the same type as orthographic input, namely a sequence of ASCII characters.

III. THE PHONOLOGICAL RULE COMPONENT

The rule language developed at IPUC is of the same SPE type as the one used in the KTH system, and the rule component of the IPUC system could therefore be translated into the notation of the present system. However, owing to certain technical differences between the input scanning routines and feature interpreting procedures of the two systems, this translation could not be done in a simple rule-by-rule fashion. One difficulty arises from the fact that in the IPUC system a segment is identifiable exclusively by its feature composition, whereas in the KTH system a segment is identifiable by its symbolic representation. Another main difference lies in the way a string of segments is scanned by a rule. In the KTH system the context is matched left to right, whereas the IPUC system starts the match at the structure to be changed and then matches the left and right context. This has necessitated the reformulation of certain IPUC rules.

IV. THE PHONETICS OF STANDARD DANISH

The vowel system is rich, with ten vowel phonemes /i e ɛ a ɣ ø œ u o ɔ/ which may be either short or long (the difference is phonological). Generally, the long and short vowels have identical phonetic quality, except for /a(:), o(:), ɔ(:)/, and due to a language specific variation in some of the vowels with the phonetic context, a total of 18 distinct phonetic vowel qualities must be distinguished: [i e ɛ æ a a- ɑ ɣ ø œ ɐ Œ u o ɔ ɒ ʌ] plus [ə].

The consonant system is correspondingly restricted: /p t k b d g f s h v ð j m n ŋ l r/. It differs from the consonantal systems of the closest germanic neighbours in the realization of, particularly, the stop series. Firstly, an opposition between /p t k/ versus /b d g/ is found only initially in syllables containing a full vowel (i.e. not /ə/). Secondly, the manifestation of the contrast is one of aspiration only. I.e. /p t k/ are unvoiced aspirated, and /b d g/ are unvoiced unaspirated. Both series are lenes, rather than fortes.

Stress is free and phonemic on the surface, although stress placement can to a large extent be predicted from the syllabic structure and the morphology, e.g. *billigst, bilist* ['bilisd, bi'lisd] ('cheapest, motorist'). Phonetically, stress is signalled mainly through fundamental frequency variation, but (full) vowel quality and (longer) duration also contribute to the identification of stressed syllables.

A complication in the phonology and phonetics is the Danish "stød", a kind of creaky voice whose occurrence, like stress, is to a large extent predictable, but on the surface, stød versus non-stød distinguishes words, like *Møller, møller* ['møl'ʌ, 'mølʌ] (a proper name, miller).

Standard Danish intonation can be decomposed into (and synthesized from) the following components: a text contour, an utterance or sentence contour, which may be decomposed into a succession of two or more phrase contours, a stress group pattern, and a stød movement. These are all speaker controlled. Involuntary variations arise due to intrinsic properties of the segments. These components are hierachically organized so that components of smaller temporal scope are superposed upon and subordinate to components of larger temporal scope. Sentence intonation is signalled by the overall global course of the intonation contour, rather than by a special local (final) movement. Standard Danish lacks an obligatory sentence accent, which makes it prosodically rather simpler than, e.g., Swedish and English, see further (ref. 3). The synthesis incorporates the utterance, stress group and stød components, and further adds certain segment conditioned fundamental frequency variations.

Below is an illustration of the parameters and the acoustic output of the utterance *Hvem har en søster der hedder Kamma?* ['vɛm' 'hɑ:' en 'søsdʌ dɑ heðʌ 'kɑma] ('Whose sister is called Kamma?'). The corresponding transcription in the text-to-speech system looks like this: [V'ÄMQ H'A3:Q EN S'ÖSDÅ2 DA3 HEDHA2 K'A3MA1].

V. CONCLUDING REMARKS

At this stage in the project we have made no formal evaluation of the system. Preliminary versions of the program have been used in a project aiming at a Danish workstation for visually impaired persons. Several imperfections still exist in both the text analysing part and the phonetic realization part of the system. However, the output is unmistakably Danish and judged useful in a variety of applications. One improvement that is still needed is a somewhat faster and more reliable NC. It is a problem with the current implementation of that component that it makes quite a few wrong choices in cases of ambiguous input. We are at present developing a new version with a better performance.

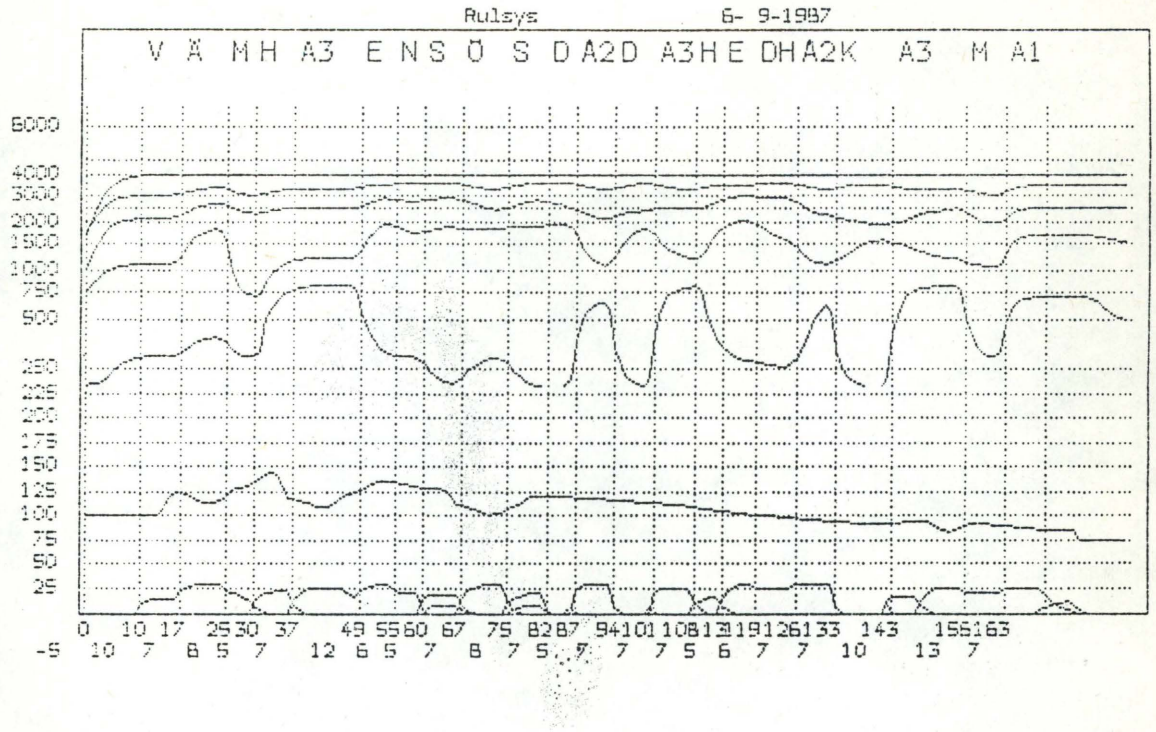

Figure 1

The Danish utterance 'Hvem har en søster der hedder Kamma?' as produced by the text-to-speech system. The parameters are, from the bottom up: Diverse amplitude parameters, fundamental frequency, and the four lowest formants.

REFERENCES

Carlson, R. and Granström, B. 1986: "Linguistic processing in the KTH multilingual Text-to-Speech system", *Conference Record, IEEE-ICASSP, Tokyo*

Molbæk Hansen, P. 1983: "An orthographic normalizing program for Danish", *Ann. Rep. Inst. Phon., Univ. Copenhagen 17*, p. 87-109

Thorsen, N. 1983: "Standard Danish sentence intonation - phonetic data and their representation", *Folia Linguistica 17*, p. 187-220.

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STRESS GROUP PATTERNS, FOCUS SIGNALLING AND SENTENCE INTONATION IN TWO REGIONAL DANISH STANDARD LANGUAGES: AALBORG AND NÆSTVED

NINA GRØNNUM THORSEN

This paper investigates stress group patterns, prosodic focus signalling and sentence intonation contours in Standard Danish as spoken on a substratum of Northern Jutland (Aalborg) and South Zealand (Næstved) dialect. The major difference between these two regions (and the difference to Standard Copenhagen Danish) is to be found in the way segments and Fo patterns are aligned in the prosodic stress group. Both regions share with Copenhagen the global signalling of sentence intonation contours, as well as a pronounced reluctance to indicate, with prosodic means, in this style of delivery, the pragmatic, contextually invited focus of the utterance.

I. INTRODUCTION

The research presented here, like Thorsen (this volume, p. 25-138), is part of a larger project which entails investigations of intonation in four Danish provincial towns, which in its turn is part of a five-year project, commenced in 1986, engaging numerous researchers, funded by the Research Council of the Humanities, called 'Spoken Danish in its varieties'.

Scope, purpose, methods and material resemble exactly those outlined on p. 27-32 to which the reader is referred for the complete treatment, but a few points are important enough to warrant a repetition here: Firstly, I have not intended to investigate the dialects proper in any of the areas I have vis-

ited, but rather the present-day regional standard language of the respective provincial towns. This language may be characterized as Standard Danish on, e.g., an Aalborg substratum. (The phonology and phonetics of present-day regional Danish is a sadly neglected area, and I cannot refer the reader to any existing literature on either Aalborg og Næstved regional Danish.) Accordingly, the material has been presented to the speakers in standard orthography and it adheres to the morphology and syntax of the standard language. (The only adjustments to the two towns have been semantic, in the names of cities to be travelled to, objects to be bought or sold, etc., so that the speakers might feel that they were talking about items familiar to them.) The aspect which suffers least, however, from the transition from dialect to regional standard language is the prosody. And prosody is also the main reason why speakers from different parts of the country can be identified (geographically), even though they conform to the standard norm in all, or most, other respects. Secondly, I am fully aware of the limitations imposed on an investigation which deals with highly monitored speech read into a microphone, in terms of loss of spontaneity and naturalness. However, the procedure enables you to isolate certain aspects of speech, while keeping everything else constant, and thus be sure that the description of, say, the relation between stress and fundamental frequency (Fo) is not fouled up by interference from, say, sentence accent or junctures. You may also reasonably expect that the intonational structures thus disclosed will appear in spontaneous speech, that they are the neutral minimum upon which a speaker operates in less rigid semantic and pragmatic circumstances.

II. PROCEDURES

1. Material

(1) To look at the realization of default and focal sentence accents, if they are manifest at all, three sentences were made up, where the same word occurs as the first, middle and last stressed word, respectively (the stressed vowels are indicated here with acute accents and intended sentence accents with plus symbols):

Kámma stámmer fra Sálling/Næstved.
(Kamma comes from ...)

Ánders og Kámma skal til Strándby/Fákse.
(Anders and Kamma are going to ...)

Tórbens søster hedder Kámma.
(Torben's sister is called Kamma.)

These utterances are presented in isolation, i.e. without any context at all, as well as in two different contexts, designed to evoke a focal sentence accent on Kamma and on some other word in the utterance, respectively. These contexts took the

form of questions to which the utterances above were the answer:

Ved du hvor Kamma er født? (Do you know where Kamma was born?)
Kámma stámmer fra Sa͡lling/Næ͡stved.

Hvem af dem er født i Salling/Næstved?
(Who among them was born in ...?)
Ka͡mma stámmer fra Sálling/Næstved.

Hvor skal de unge holde ferie?
(Where are the children going for holidays?)
Ánders og Kámma skal til Stra͡ndby/Fa͡kse.

Hvem skal til Strandby/Fakse foruden Anders?
(Who, besides Anders, is going to ...?)
Ánders og Ka͡mma skal til Strándby/Fákse.

Hvad hedder Torbens søster?
(What is Torben's sister's name?)
Tórbens søster hedder Ka͡mma.

Hvem har en søster der hedder Kamma?
(Who has a sister called Kamma?)
To͡rbens søster hedder Kámma.

For a discussion of sentence accent versus emphasis for contrast and their (different) manifestations, see Thorsen (this volume, p. 28). Note that the research presented here is not intended as a contribution in the more syntactically or semantically oriented debate about what determines focus placement; when and whether a focus is 'broad' or 'narrow'; what is focus and what is contrastive stress or emphasis; what determines the 'default' location of focus; etc. For an excellent treatment of these questions, see Ladd (1978) and the references therein, and for a more recent overview, see Fretheim (1988).

The nine utterances above will also allow me to look at the relation between stress and Fo as well as the realization of terminal declarative intonation.

(2) To further illustrate sentence intonation phenomena, a fairly long declarative utterance was made up:

Kófoed og Thórsen skal med rútebilen fra
[Brønderslev til Skágen]/[Fúglebjerg til Sórø]
klokken fíre på tírsdag.
(K. and T. are taking the bus from ... to ... at four o'clock on Tuesday.)

as well as a dialogue with a question word and a one-stress echo-question:

Hvor lángt ér der fra [Løkken til Strándby]/
[Næstved til Fákse]?
Til Strándby/Fákse? - Der er cirka 80/30
kilometer.
(How far is it from ... to ...?
- To ...? - It is about 80/30
kilometres.)

(3) Two utterances occur which have (a) one stress group with a fairly large number of post-tonic syllables, and (b) a polysyllabic word with stress on its last syllable (underlined below - this last to certify that word boundaries leave no trace in Fo, as it does not in Copenhagen Danish, cf. Thorsen 1980a, 1982, 1984):

De sídste dýbhavsfiskere må snárt lægge óp./
Den bédste af cámpingpladserne vil snárt blive
lúkket.
(The last of the deep sea fishermen will soon have to lay up their ships./The best among the camping sites will soon be closed down.)

Fabríkken solgte elektroník for tó
millióner króner.
(The factory sold electronics
worth of two million crowns.)

To look in more detail at the coordination of Fo and segments, five utterances were constructed which contain a stress group (underlined below) whose voiced part grows progressively shorter, from top to bottom:

De fik kánerne frém til nýtår.
(They got out the sleighs for New Year's.)
Hun fik kánderne fýldt til kánten.
(She had the jugs filled to the brim.)
Hun fik kánden fýldt med mælk.
(She had the jug filled with milk.)
Kóldt vánd slúkker tørsten.
(Cold water quenches your thirst.)
Den grå kát krádser. (The grey cat scratches.)

The last two utterances are ill considered on my part. I neglected the fact that here the stress group under scrutiny is not the first one in the sentence. And to the extent that an initial juncture is manifest - which will make the first stress group differ from succeeding ones - the five underlined sequences are not immediately comparable.

(4) Turísterne forøger befólkningstallet om sómmeren.
(The tourists increase the population during the summer.)

Mänge vēstjyder/forrētninger lēver af turīsterne.
(Many West Jutlanders/shops live off the tourists.)

These two utterances should disclose any final lengthening, granted that the second one did not receive a sentence accent on the last word (which it did not, see further below). Further, the 'Kamma' utterances can of course also be used to measure duration of initial and final 'Kamma's.

The total of twenty utterances/dialogues were typed out on library index cards in three different randomizations, twice, numbered consecutively from 1 to 120.

2. Speakers and recordings

The speakers from Aalborg were recorded in April 1987 in an ordinary office with a dynamic Sennheiser MD21 microphone, a Revox Studer tape recorder, on to Agfa PE36 tape, at a speed of 7½ ips. They were two males (PP and JW) and two females (IK and BL), all in their thirties, all born and raised in Aalborg. One of the females (BL) sounded, upon listening to the tapes, only very slightly regional, and was accordingly discarded from further processing.

Five speakers from Næstved participated. Four of them (two males, TJ and MC, and two females, CS and HH) are teen-agers, recruited from a local high-school. They were recorded at a local radio station in October 1986 with a dynamic AKG D130E microphone, a Revox PR99 tape recorder, on to Agfa PEM369 tape, at a speed of 7½ ips. The fifth speaker, ONT, is a 28 years old collegue, male, who was recorded in our quasi-damped room, with a Sennheiser MD21 condensator microphone, a Revox A700 tape recorder, Agfa PEM369 tape, at 7½ ips. The two teen-ager males were used only for a limited part of the material. One (MC) spoke at a devilish rate, and the other (TJ) produced predominantly non-terminal sentence intonation contours. Thus, the bulk of the results presented rests on three speakers from each region.

For an account of registration and measurements, see this volume, p. 30-31.

III. RESULTS

A. FOCUS INDICATION

1. Auditory evaluation

I should stress first that sentence accents, as they are generally understood in the literature, namely extra prominent Fo movements associated with one or several stressed syllables in

the utterance, are found nowhere in this material, just like they are absent in Copenhagen Danish. See further Thorsen (this volume, p. 25-138) and the references therein. However, a restricted number of utterances were found, while listening to the tapes and providing the mingograms with identification and text, with what may be termed a focus indication. I.e. when replaying in isolation these (few) utterances from context, it was obvious what question they were the answer to. The results of this auditory evaluation are given in Tables I and II, and the acoustic foundation for my auditory impressions is presented in the succeeding section. (I am the sole auditory judge in this case, but although certain shady cases might receive another verdict from other listeners, I have no doubt that the main trends will remain unchanged.)

Table I

Number of focus assignments produced by three speakers from Aalborg in percentage of the possible maximum (given beneath the legend to each column), determined a priori by the context (i.e. columns should add up to one hundred.)

	Contextually invited focus assignments (FA)			
Sentences realized	None (51)	Initially (33)	Medially (17)	Finally (51)
Without FA	92%	0%	65%	80%
Initial FA	0%	85%	0%	0%
Medial FA	0%	15%	35%	0%
Final FA	8%	0%	0%	20%

The 8% (4 items) in the lower left of Table I are due to one speaker, PP, and should probably go down as 'mistakes' due to the nature of the reading task, and caused by the awareness of contexts where this rendering would be appropriate. The 15% (5 items) medial foci which were invited by the context to be initial are due to one speaker (IK). They are 'mistakes' which I cannot explain except as, again, due to the nature of the reading task. (One of my Stockholm speakers also misplaced some initial accents to medial position in this utterance, cf. p. 34.)

Table II

Number of focus assignments produced by three speakers from Næstved in percentage of the possible maximum (given beneath the legend to each column), determined a priori by the context (i.e. columns should add up to one hundred.)

	Contextually invited focus assignments (FA)			
Sentences realized	None (54)	Initially (36)	Medially (18)	Finally (54)
Without FA	100%	67%	89%	100%
Initial FA	0%	33%	0%	0%
Medial FA	0%	0%	11%	0%
Final FA	0%	0%	0%	0%

The 11% (2 items) realized medial focus assignments are due to one speaker (ONT); the 33% (12 items) initial foci are due to ONT (10 items) and HH (2 items).

The results from Næstved are very reminiscent of the two Copenhagen speakers, cf. this volume (p. 34-35), one of whom never produced any perceptible foci, the other producing initial and medial foci, when invited by the context, but never any final ones.

Whether or not the difference in focus assignment between Aalborg and Næstved speakers is significant and consistent cannot be determined, the number of speakers from each region being too limited. We can say of both regions that isolated utterances are always realized without any of the stressed words being more prominent than the others. Final focus signalling is extremely rare, medial focus indication is uncommon, especially in Næstved, whereas initial foci get signalled most of the time by Aalborg speakers, but not very often by Næstved speakers. The scarcity of final prosodic focus indication is interesting in the light of the results from Bornholm and Malmö (cf. p. 69), where final position attracts more prosodic focussing than medial position, prosodic focus signals being facultative in these two regions, and also because final position is where default sentence accents land in languages which possess this phenomenon. Such a difference in the location of prosodic centres of gravity (early versus late in the utterance) may reflect differences in spoken language syntax. This is obviously an immense field for future research.

2. Fundamental frequency

The Fo tracings should establish the acoustic foundation for my auditory impressions and justify my rejection of focus signalling as 'sentence accent' in its customary sense.

(a) Aalborg

Figures 1-3 display average tracings of the three different utterances in their various editions. The only noteworthy difference between speakers is the somewhat slower rise from the low minimum in the stressed syllable to the peak of the Fo pattern with IK. This difference corresponds with a difference in stressed vowel duration in initial, neutral 'Kamma', averaging 9.3 cs and 9.5 cs with PP and JW, respectively, versus 14.0 cs with IK. Thus, the peak of the pattern coincides with post-tonic vowel onset with all three speaker. Range spanned rarely exceeds 8 semitones.

(i) Initial 'Kamma' Stress group patterns in the neutral editions (i.e. the context free utterances, full lines in the figures) are characterized by a very slight (one semitone, approximately) and brief fall to the low onset of a fairly considerable rise (spanning approximately 5 semitones). This rise ends with the onset of the post-tonic vowel, which is falling, and as we shall see below, this fall is both sharp end extensive when the number of post-tonics allows for its full development. An indication is given already here by JW, who pronounced 'Kamma stammer fra Salling' with secondary stress only on 'stammer', i.e. 'stammer fra' becomes part of the preceding prosodic stress group, as far as its Fo course is concerned. PP's 'stammer' also sounded reduced in prominence, but it has retained, at least partly, a rising-falling movement. IK and JW also demonstrate the tendency, known from Copenhagen Danish (cf., e.g., Thorsen 1980b) for

Figures 1-3

Average fundamental frequency tracings (logarithmic display) by three Aalborg speakers of three utterances with different focus locations. Speakers are identified at the top left of each figure, as is the frequency value which is the basis for the conversion to semitones. The number of items behind each average is given at the top right of each subpart of the figures. Utterances with no perceived focus are traced in full lines, utterances with perceived initial focus in dotted/broken lines, utterances with perceived medial focus in dotted lines, and utterances with perceived final focus in broken lines. Note that JW pronounced 'Kamma stammer fra Salling.' with secondary stress only on 'stammer'.

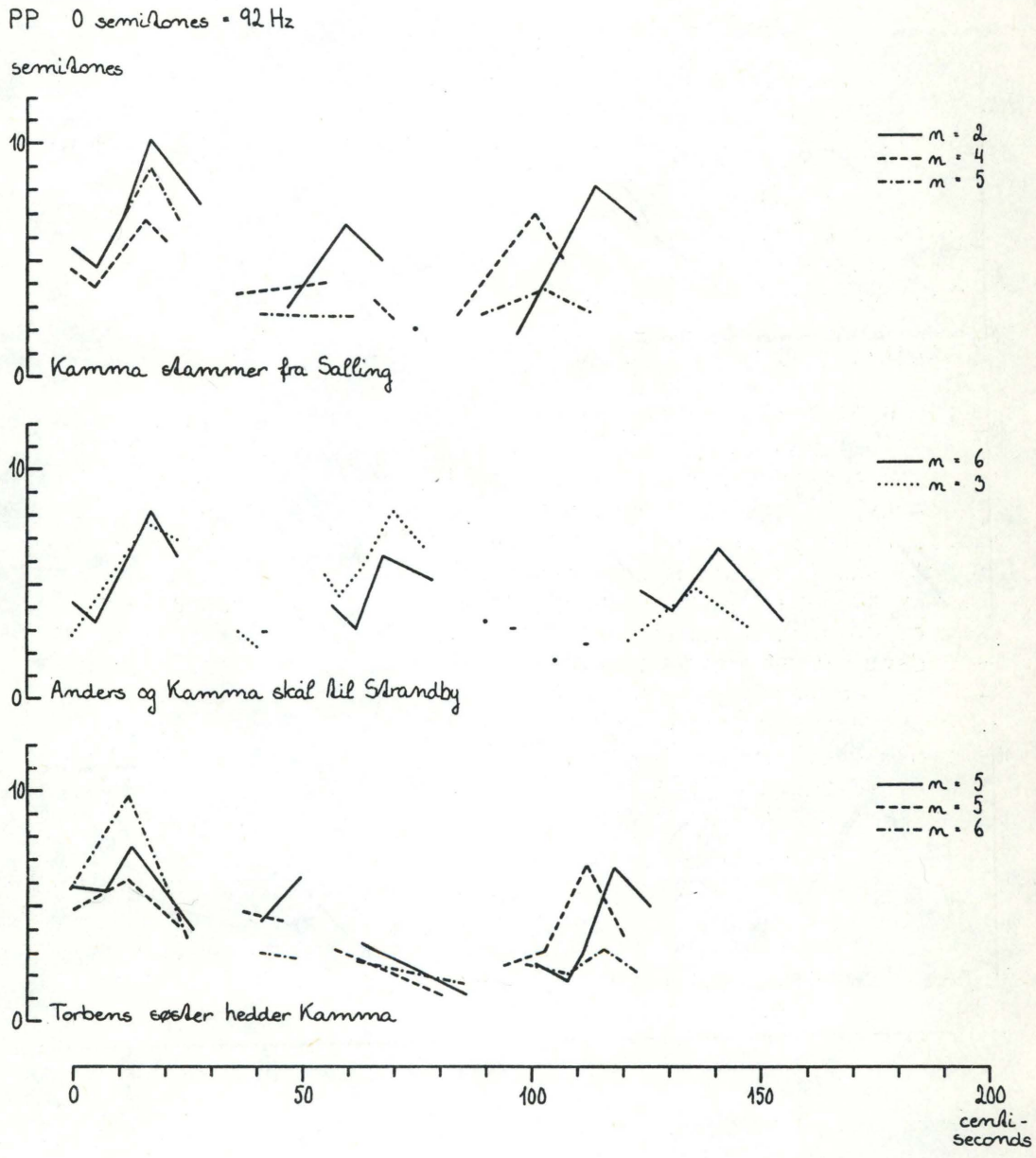

PP 0 semitones = 92 Hz
semitones
10
0
Kamma klammer fra Salling
n = 2
n = 4
n = 5
10
0
Anders og Kamma skal til Strandby
n = 6
n = 3
10
0
Torbens ræve hedder Kamma
n = 5
n = 5
n = 6
0
50
100
150
200
centi-seconds

Figure 1

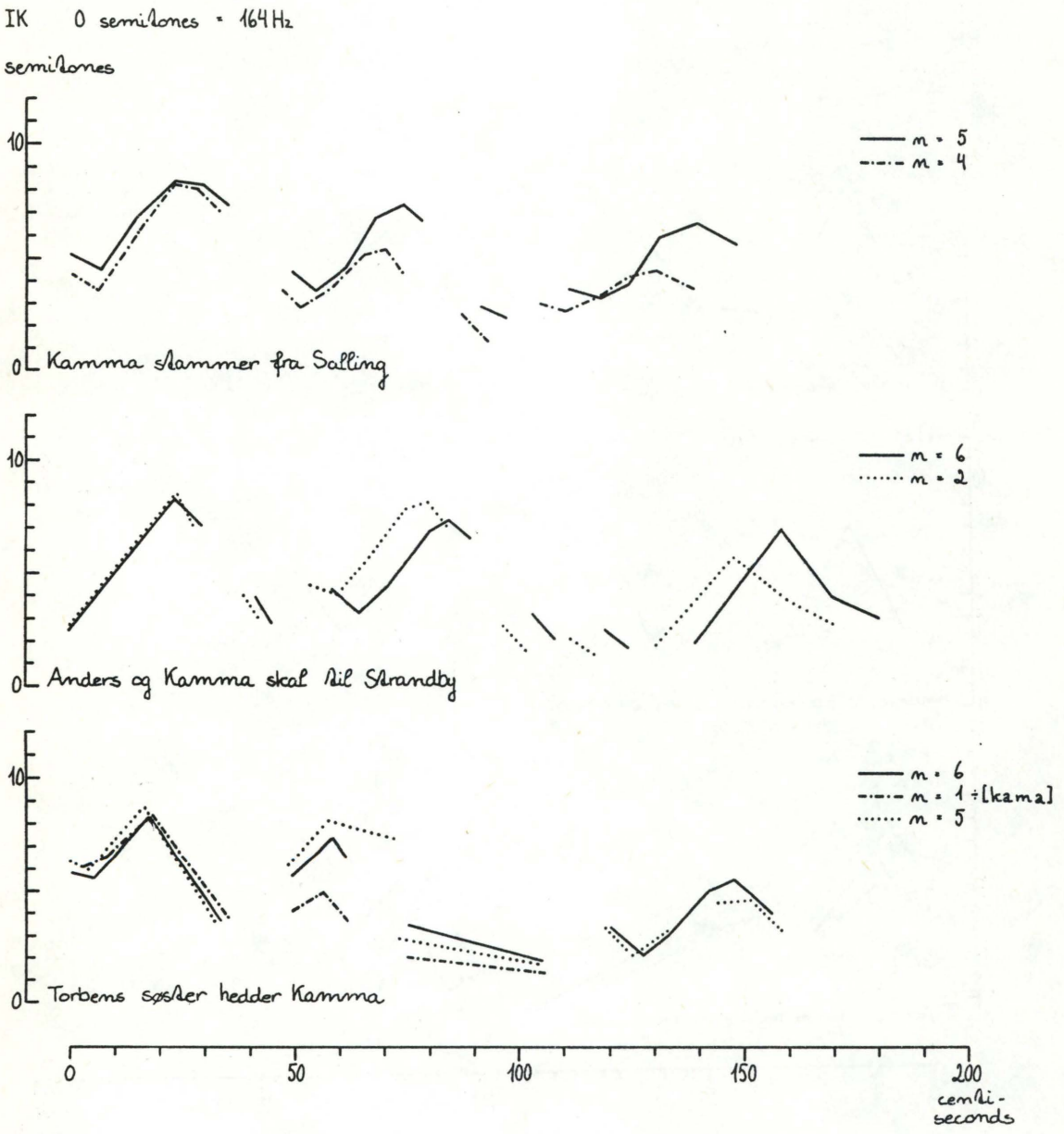

IK 0 semitones = 164 Hz
semitones
10
0
n = 5
n = 4
Kamma slammer fra Salling
10
0
n = 6
n = 2
Anders og Kamma skal til Strandby
10
0
n = 6
n = 1 ÷ [kama]
n = 5
Torbens søster hedder Kamma
0
50
100
150
200
centi-seconds

Figure 2

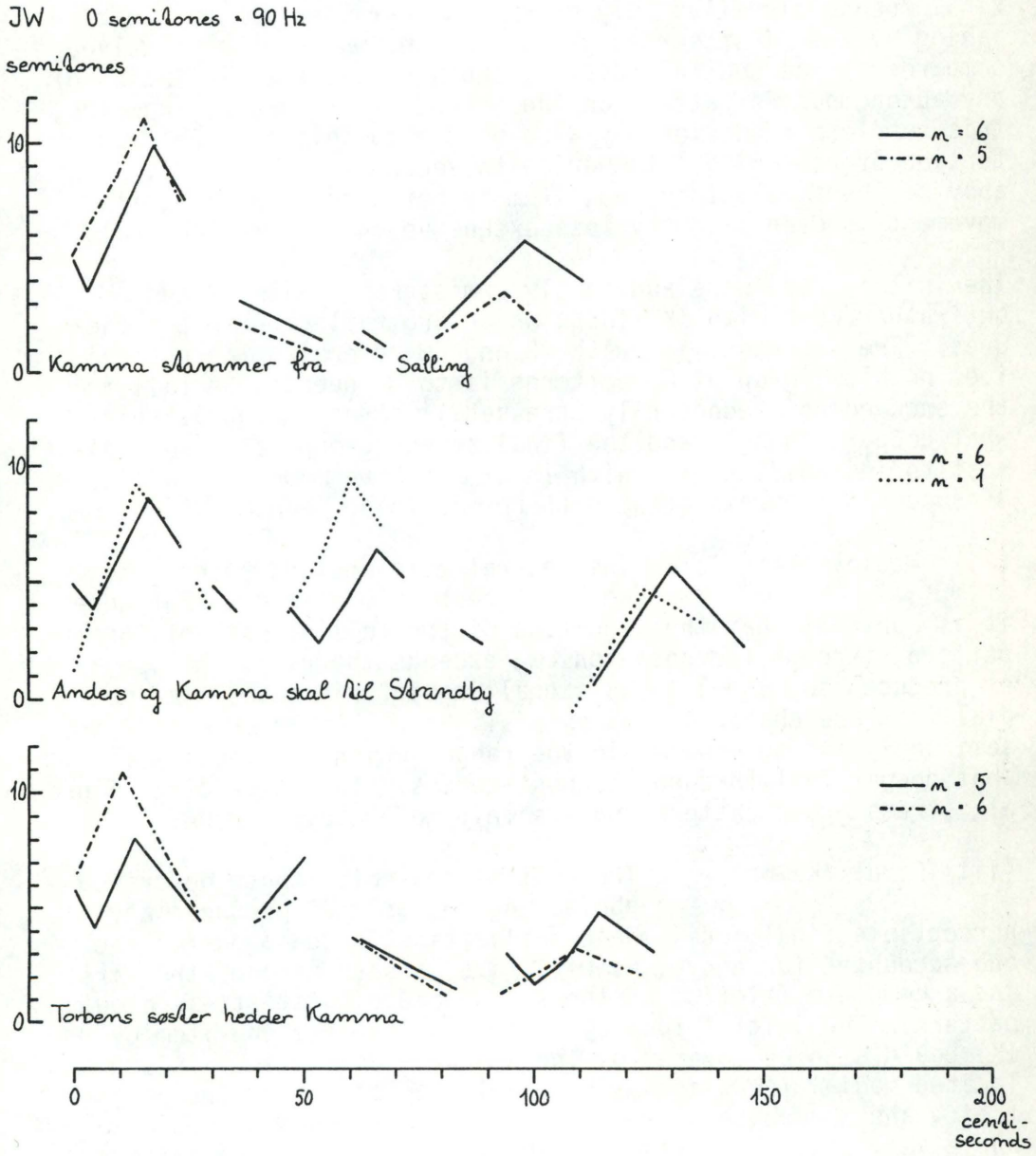

JW 0 semitones = 90 Hz
semitones
10
0
Kamma slammer fra Salling
n = 6
n = 5
10
0
Anders og Kamma skal til Strandby
n = 6
n = 1
10
0
Torbens søster hedder Kamma
n = 5
n = 6
0
50
100
150
200
centi-seconds

Figure 3

stress group patterns to shrink from the onset to the offset of the utterance, i.e. the rise becomes progressively less extensive in frequency from left to right. The global course, the intonation contour proper (as defined by the mutual relation between the stressed vowels) is mildly and approximately linearly falling, in these short terminal declaratives.

Final focus, signalled only by PP, is characterized by a diminishing of the first stress group pattern, whose rise is halved compared to the neutral edition, and a complete annihilation of any autonomous Fo pattern on the second stress group. However, this complete reduction may also be due to this speaker's intention of rendering 'stammer' with secondary stress, cf. above. The final, focussed, item is not boosted at all, its movement is even slightly less extensive than in the neutral.

The initial foci were auditorily unmistakable with PP and JW but rather weak with IK, facts which are reflected in the figures. The focussed item with PP and JW resembles the neutral, i.e. no blowing-up of Fo patterns is to be seen. The fall to the succeeding (secondarily stressed?)[1] stress group is somewhat deeper, though, and the final stress group has shrunk almost to insignificance. With IK a much more modest reduction of succeeding stress group patterns is to be seen.

(ii) Medial 'Kamma' The neutral editions add nothing to what has been said already. But here it is apparent that the magnitude of the falling part of the pattern, through the post-tonics, exceeds the rise. No speaker produced any final focus signalling in this case. The meddial foci are characterized by a slight (a little more that one semitone) lifting upwards in the range, which entails a somewhat deeper fall through the post-tonics. The succeeding, final, stress group pattern appears only moderately shrunk.

(iii) Final 'Kamma' The neutral resembles those described above. Again, only PP produced any perceptible final foci, whose realization is analogous to the one accounted for above, as well, i.e. a shrinking of the first and a complete deletion of the second and closest stress group pattern. The initial foci by PP and JW (and the one item by IK) could also be covered by the account just given. IK's dislocated medial foci, again, have a lifted stressed plus post-tonic, and thereby a steeper fall to succeeding post-tonics, and a very slight reduction of the final stress group pattern.

Utterances with perceived foci are visibly shorter than the neutral ones (with the exception of IK's 'Torbens søster hedder Kamma' with medial focus). I assume that this shortening, which is approximately evenly distributed over the whole utterance, is due mainly to the presence of the focus. See further p. 64-68 in this volume, about duration and sentence accents in Bornholm Danish.

To summarize: Sentence intonation contours are globally falling, and very mildly so, with no trace of any particular, steep final fall, entirely in line with the model posed for Copenhagen Danish (Thorsen 1978 - see also p. 61 and 62 in this volume). Stress group patterns are rising-falling, with a fall which is more extensive than the rise, if enough segmental material is present to carry it. The slope of the rise seems to be adjusted to (inversily proportional to) the stressed vowel duration, in order that the high turning point may coincide with the onset of the first post-tonic vowel. The fall appears to be executed mainly between the first and second post-tonic and to level off after that. This rapid and rather deep fall is probably what accounts for the auditory impression of a "high-low" type stress group pattern, even though the stressed vowel does not constitute the maximum in the Fo course. Final and medial focus realization is rare. Final focus diminishes the first, i.e. farthest, stress group pattern and deletes the penultimate, nearest one, but does not change the pattern of the focussed item itself. Medial focus has en even more modest effect, which lifts the stressed and first post-tonic slightly upwards, and reduces, but only very slightly, the final stress group pattern. Initial focus inverts the final one, i.e. the immediately succeeding stress group pattern is deleted, the final and farthest one retains a shrunken rise-fall. - It would have been very interesting to see how emphasis gets expressed in Aalborg. Whether the emphasized item would come out with expanded Fo patterns and more (and more far-reaching) suppression of the surroundings (especially with medial emphasis). (That is how emphasis for contrast is expressed in Copenhagen, cf. Thorsen 1980b.) This question will have to remain unsolved for the time being. I did not dare include in the material also contexts and utterances with emphasis (e.g. of the type 'Was Kamma born in Salling or in Strandby? - Kamma was born in Salling.) for fear that speakers would get confused bout and not distinguish focus and emphasis systematically.

(b) Næstved

Figures 4-6 display average tracings of the three utterances. Again, speakers differ (as in Aalborg) in the slope of the rise in the stress group pattern. ONT's rises are steeper, apparently because they are more extensive. It is true generally of all three speakers that the short stressed vowel is centered around the low turning point and the first post-tonic vowel is

Figures 4-6

Average fundamental frequency tracings by three Næstved speakers of three utterances with different focus locations. See further the legend to figures 1-3

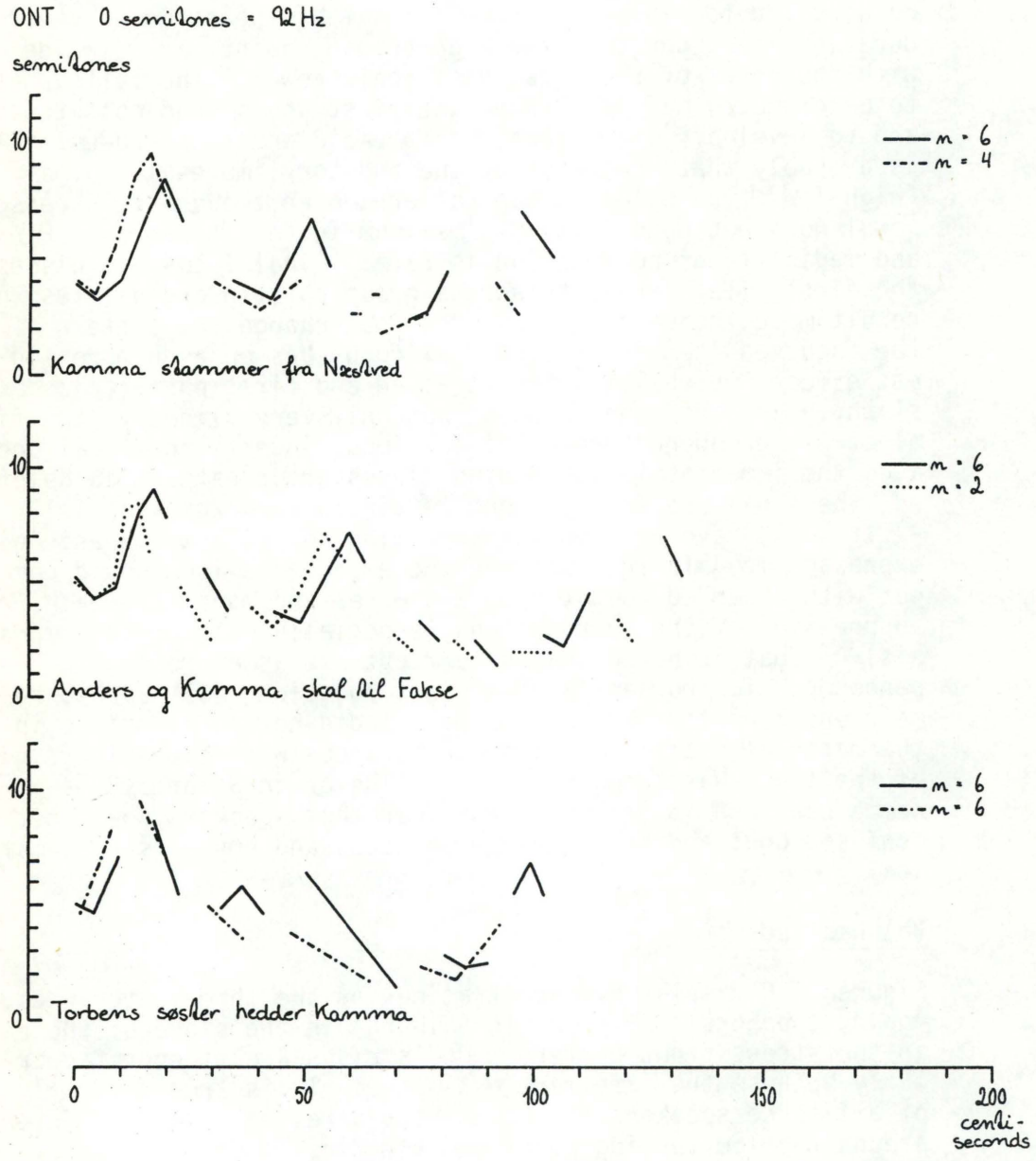

ONT 0 semitones = 92 Hz
semitones
10
0
n = 6
n = 4
Kamma skammer fra Næstved
10
0
n = 6
n = 2
Anders og Kamma skal til Fakse
10
0
n = 6
n = 6
Torbens søsker hedder Kamma
0
50
100
150
200
centi-seconds

Figure 4

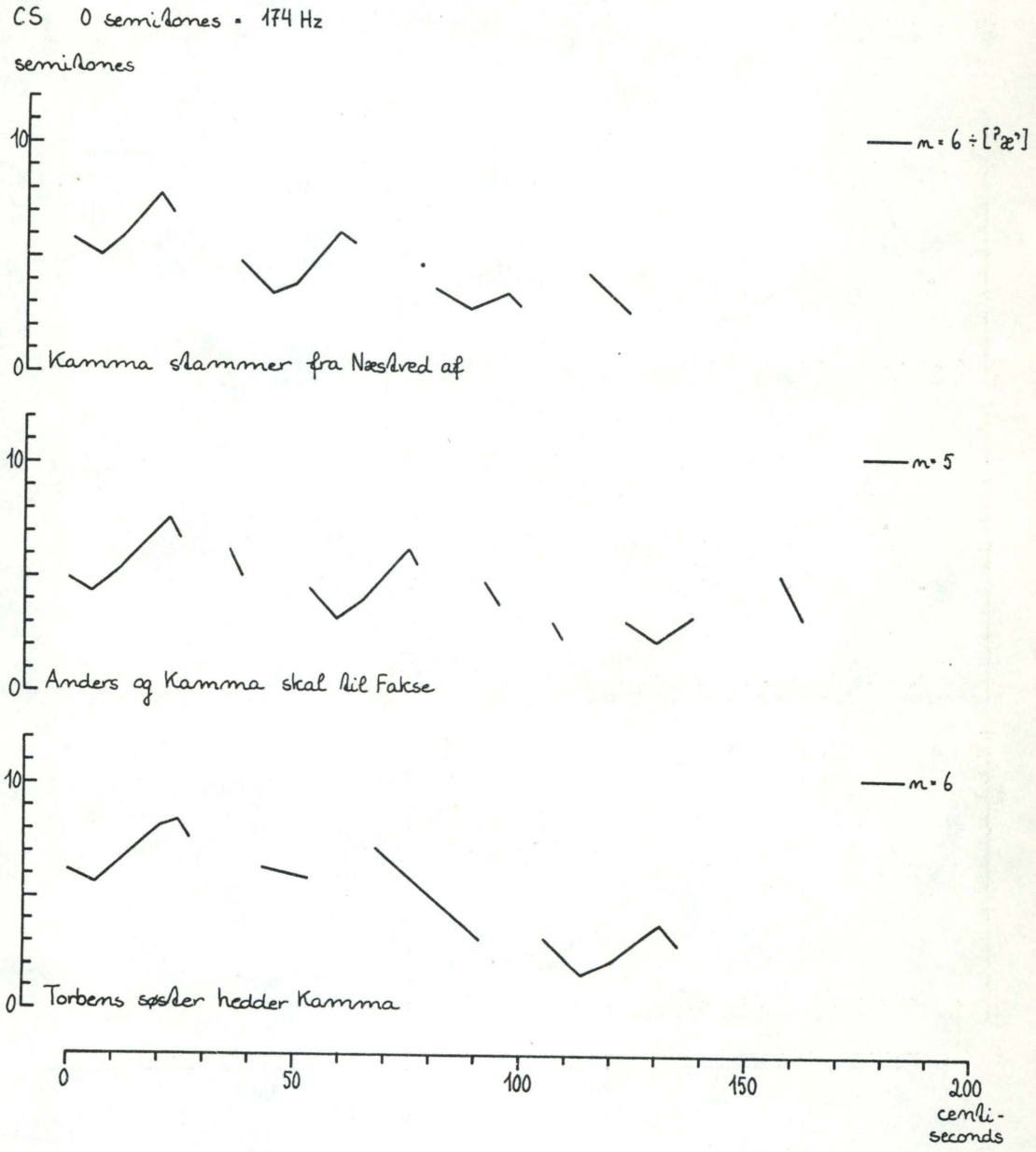

CS 0 semitones = 174 Hz
semitones
10
0
Kamma skammer fra Næstved af
m = 6 ÷ [ʔæˀ]
10
0
Anders og Kamma skal til Faxse
m = 5
10
0
Torbens søster hedder Kamma
m = 6
0
50
100
150
200
centi-seconds

Figure 5

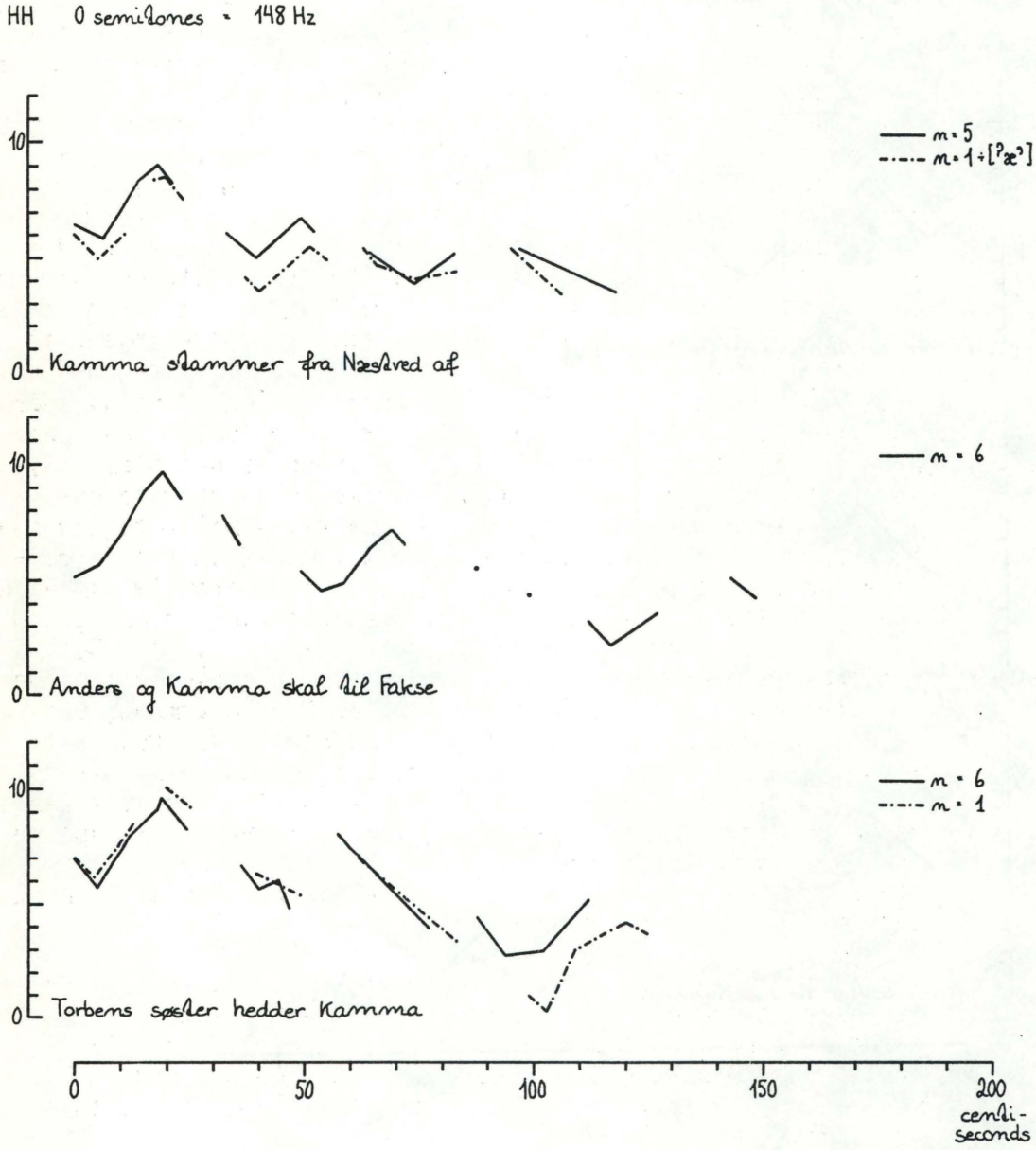

HH 0 semitones = 148 Hz
10
0
Kamma stammer fra Nærved af
m = 5
m = 1 ÷ [ʔæˀ]
10
0
Anders og Kamma skal til Fakse
m = 6
10
0
Torbens søster hedder Kamma
m = 6
m = 1
0
50
100
150
200
centi-seconds

Figure 6

centered around the high turning point in the pattern. When the stressed vowel is phonetically long, as in 'Torbens', it covers more of the rise and the post-tonic is transposed in time, i.e. the high turning point coincides with its onset. At least this is true of ONT and HH. Speakers' ranges are modest, not exceeding eight semitones. Their intonation contours are slightly and globally declining, with no trace of any final, local falls. Stress group pattern rises are slightly less extensive than in Aalborg, covering 3-4 semitones, and have a weakly pronounced trend towards left-to-right reduction of the magnitude of the rise. The fall through the post-tonics is gradual (as opposed to Aalborg), and not as extensive, compared to the rise (again compared to Aalborg). The scarce initial focus indications (10 items with ONT, two with HH) are contained in a diminishing of succeeding stress group patterns, more so with the closest (middle) one, but not a complete deletion. HH is much less explicit than ONT. The two medial foci with ONT seem to be mainly signalled through a near-deletion of the succeeding (final) pattern. (Compare this with Aalborg, where it was the focussed item itself which manifested its focal status.) The prosodic manifestation of focus shortens the whole utterance (the apparent exception in the lower part of figure 6 may be accidental - there is one item only). Thus, focus signalling in Næstved seems to be carried out, when it occurs at all, in a manner exactly similar to Copenhagen (where it is also optional and excluded from final position), cf. this volume p. 60. It is less generously signalled than in Aalborg, where immediately neighbouring stress group patterns are deleted when focus is initial or final. Both regional languages, when they express focus prosodically, do so not through a larger and more explicit Fo movement, but rather through a reduction of surrounding stress group patterns, a stress reduction on surrounding words. This is in sharp distinction to the (focal and default) sentence accents found in Bornholm and Stockholm, cf. p. 35-56 in this volume, and this is the reason why I prefer not to employ the term 'focal sentence accent' at all in the description of Aalborg and Næstved (and Copenhagen).

The most intriguing question, when Aalborg, Næstved and Copenhagen are compared, lies in the fine details of the stress group pattern: the slope and extent of the rises and falls, and the coordination of segments with the Fo pattern. This will be treated further below, but let us look at the long declaratives and the questions first.

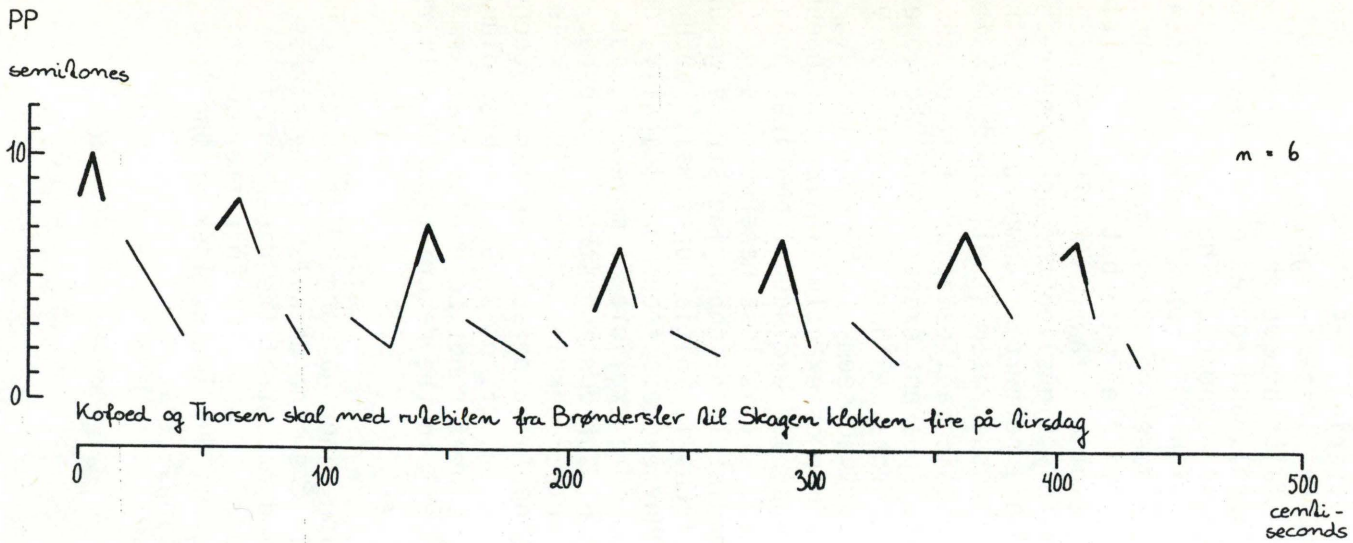


Figure 7

Average fundamental frequency tracing of a long terminal declarative utterance by three (including figures 8 and 9) Aalborg speakers. The vocalic part of the stressed syllables is drawn in thicker line. The time scale is compressed compared with other figures. See further the legend to figures 1-3.

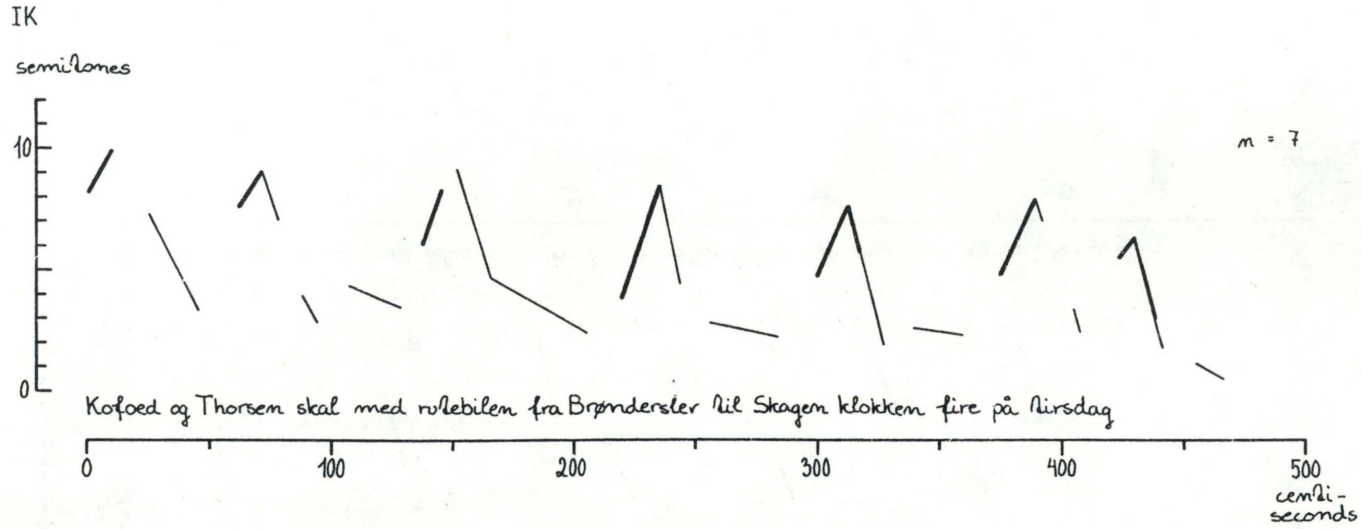


Figure 8 - see legend to figure 7

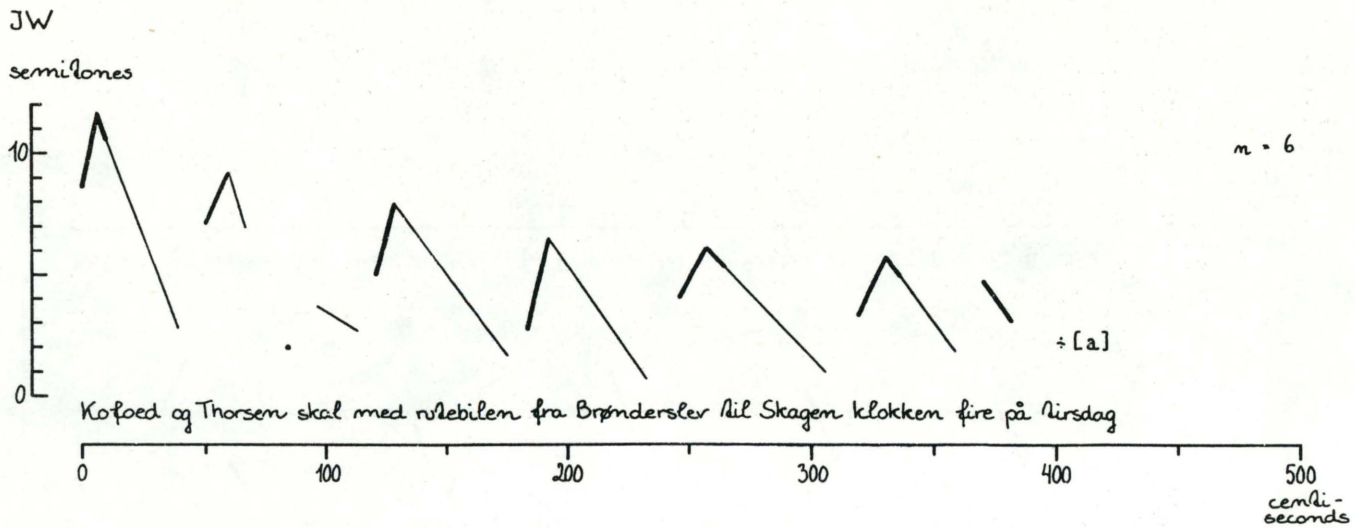


Figure 9 - see legend to figure 7

B. SENTENCE INTONATION

1. The long declarative

(a) Aalborg

Figures 7-9 display the average tracings of 'Kófoed og Thórsen skal med rútebilen fra Brønderslev til Skágen klokken fíre på tírsdag.' The three speakers behave remarkably alike, except that the stress group pattern fall is evenly distributed over the post-tonics with JW, as opposed to the asymptotic fall with PP and IK, cf. above. The global course falls over the first two to three stress groups and then levels out with PP (and JW), whereas it is evenly distributed over the whole utterance with IK, where it amounts to a mere two semitones. With PP the fall seems to be carried by the stressed vowels, i.e. the peaks in the Fo course, since the post-tonics reach approximately the same low level throughout the seven stress groups. The same might be said for JW, though a slight falling-rising trend through maxima as well as minima is observed. The effect with those two speakers is the often observed diminishing of stress group pattern range from left to right, which is not really apparent with IK.

Although the final stress group is not associated with any particularly extensive fall, it does differ from preceding ones in this utterance: the stressed vowel is predominantly falling, as opposed to the preceding rising stressed vowels. This feature is not apparent in any of the other terminal declaratives in the material, cf. the 'Kamma' utterances above, and see further below as well. (It is particularly not the case in the utterance 'De sídste dýbhavsfiskere må snárt lægge óp.' which ends in a short stressed vowel.) This is an indication, however, that Aalborg speakers have a special means to express terminality, when required to do so. (It parallels the systematic and exceptionless inversion of low-high patterns into high-low ones in Bornholm, cf. p. 45 and 128-30 in this volume.) The requirement may arise from the total length of the utterance. I.e. with the rather restricted speaking range employed, a global fall is not steep enough to meet the demands of a terminal declarative intonation, so a final, local signal is superposed on the last stressed (and perceptually salient) vowel, whose movement becomes falling rather than rising. What this implies for the much debated question of pre-planning or not of gross intonational events (cf. Thorsen 1983a, 1983b, 1985, 1986, 1987, and this volume) is uncertain. A material which manipulated utterance length, keeping other factors constant would be required to determine whether global trends could be ascribed to iterative application of local rules, where each stress group is downstepped by a certain fraction relative to the preceding event, or whether the realization of a stress group, in terms of location in the frequency range, is demonstrably sensitive not only to preceding but also to upcoming events. What the Aalborg speakers do demonstrate here, however, is that more than one strategy is open for them to signal terminal declaratives, but whether one involves pre-

Figure 10

Average fundamental frequency tracing of a long terminal declarative utterance by three (averaged) Næstved speakers. The vocalic part of the stressed syllables are drawn in thick lines. The time scale is compressed compared with other figures. See further the legend to figures 1-3.

planned global contours, the other not is an open question, so far.

(b) Næstved

Speakers behaved sufficiently alike, qualitatively and quantitatively, to justify a grand mean. Thus, figure 10 displays 'Kófoed og Thórsen skal med rútebilen fra Fúglebjerg til Sórø klokken fíre på tírsdag.' as the mean of means from ONT, CS, and HH.

Note that there are three stressed vowels which have falling movements. This must be ascribed to the strong stød, characteristic of this region, cf. Thomsen (1987). These speakers all produced a prosodic boundary before the complement of place, sometimes accompanied by a pause (suppressed in the figure), sometimes not, i.e. the intonation contour is reset between the stressed syllable of 'rútebilen fra' and 'Fúglebjerg til', creating two prosodic phrase contours. Each of these is globally falling, i.e. the fall is evenly distributed over the three and four, respectively, stress groups in each prosodic phrase, though maintaining a global fall, since the second phrase contour is not reset all the way up to where the utterance onsets, and since the first phrase contour ends higher than the second one. This is entirely in line with how long utterances behave in Copenhagen, cf. Thorsen (1983a). The fact that stress group pattern falls seem to have shrunk in the last two stress groups is not, presumably, a finality cue, but due rather to the comparative brevity of the segmental material, cf. further below.

I would argue, just as I did for Copenhagen (Thorsen 1983a), that these contours could not have been produced without look-ahead and preplanning in their actual, on-line production.

2. The questions

(a) Aalborg

The question with question word contains four stressed syllables, i.e. it is comparable in length to the 'Kamma' utterances and to the utterance 'De sídste dýbhavsfiskere må snārt lægge óp.' - If we let the peaks of the Fo patterns determine the overall downdrift and define this in terms of the interval between first and last peak, it turns out that the questions depicted in figures 11-13 have somewhat less downdrift than the three neutral 'Kamma' utterances and '.. dýbhavsfiskere ..' The average downdrift in the four declaratives versus the downdrift in the question is as follows: JW 3.9/3.0 semitones, PP 2.0/1.0 semitone, IK 2.8/1.0 semitone. Note, though, that a certain slope is maintained, and is evenly distributed over the whole utterance, with no trace of any final rise (not even less of a final fall) in these question word questions. The one-word echo question is characterized by a higher peak (as high as or higher than the onset of the preceding question), and thus a higher rise, since the onset is as low as the onset of the final stress group in the preceding question. Again, the stress group terminates in a fall, and the interrogative status of this word is accordingly not signalled by any (absolutely) final rise, either.

(b) Næstved

The question word questions in figures 14-16 do not look systematically different from the declarative utterances examined above, i.e. there is no consistent difference in the overall slope, nor is the final stress group significantly different from preceding ones. These questions have the intonation of terminal declaratives. The one-word echo-question looks like any other stress group, except that it is positioned higher in the frequency range (on a level with utterance initial stress groups in general) with HH and CS, whereas with ONT the rise

Figures 11-16

Average fundamental frequency tracings of a question with question word, followed by an echo-question. Three Aalborg speakers (PP, IK, JW) and three Næstved speakers (ONT, CS, HH). The vocalic part of the stressed syllables is drawn in thicker line. See further the legend to figure 1-3.

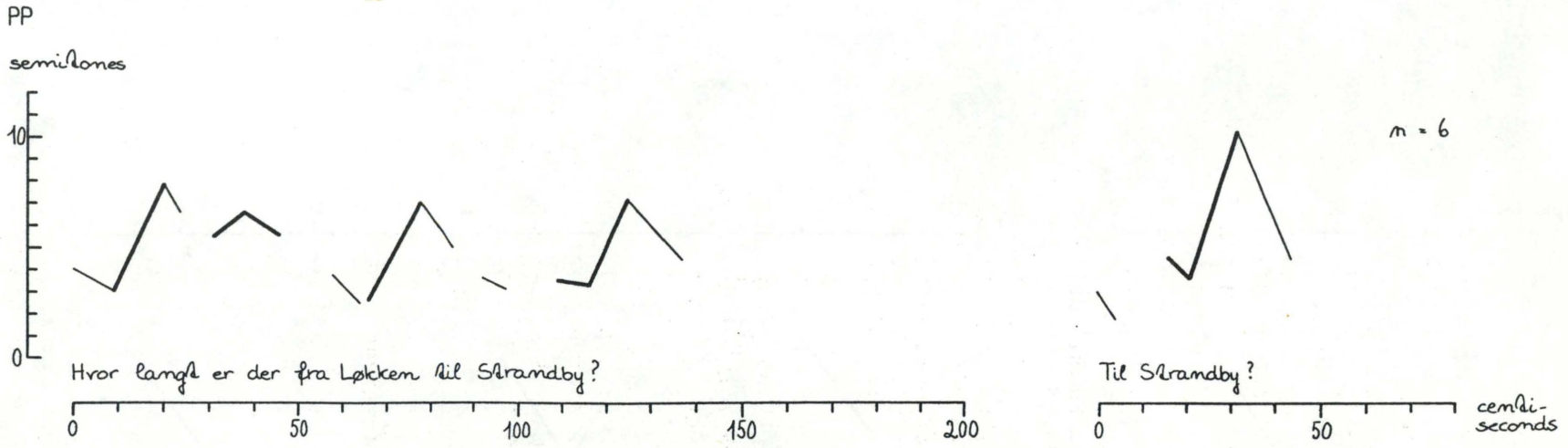

PP
semitones
10
0
Hvor langt er der fra Løkken til Strandby?
0
50
100
150
200
n = 6
Til Strandby?
0
50
centi-
seconds

Figure 11

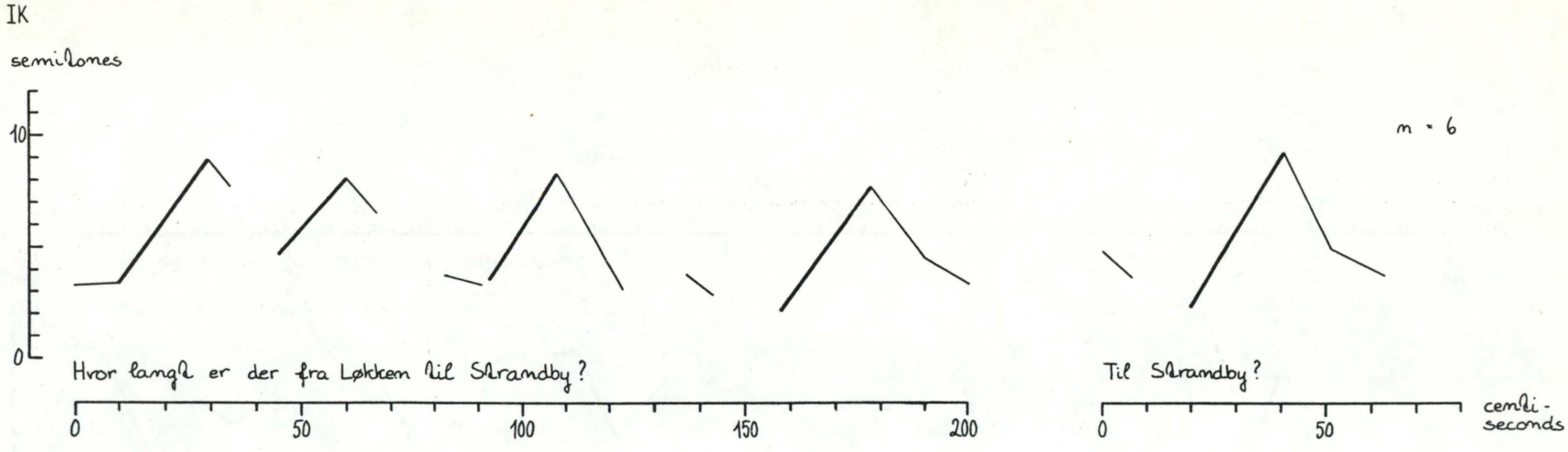

IK
semitones
10
0
Hvor langt er der fra Løkken til Skrandby?
0
50
100
150
200
m = 6
Til Skrandby?
0
50
centi-
seconds

Figure 12

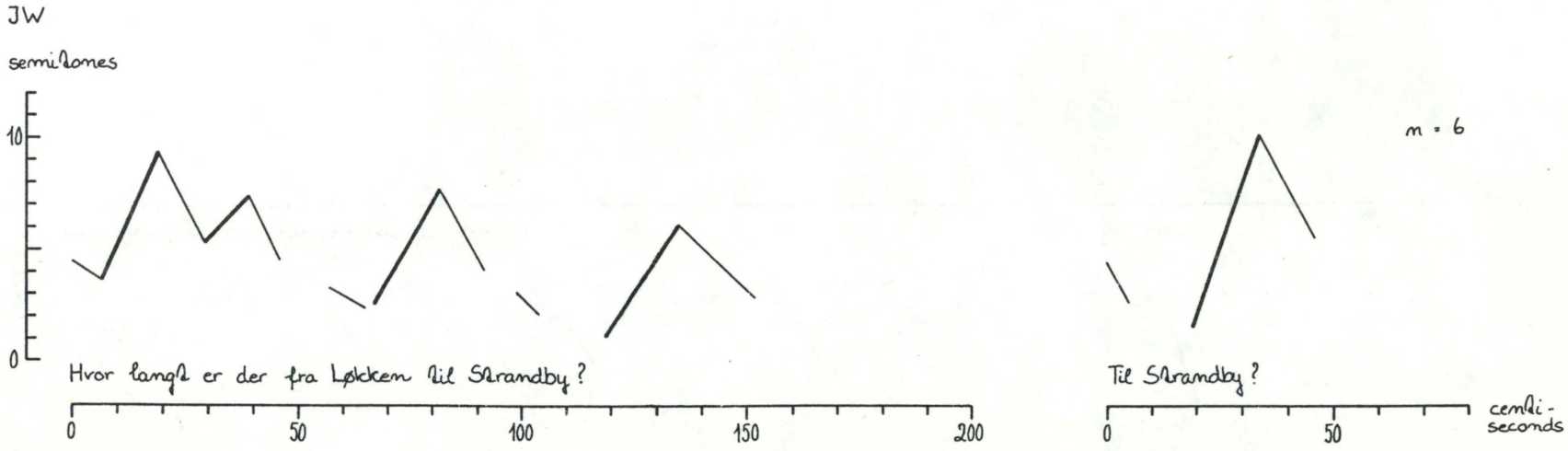

JW
semitones
10
0
Hvor langt er der fra Løkken til Strandby?
0
50
100
150
200
m = 6
Til Strandby?
0
50
centi-
seconds

Figure 13

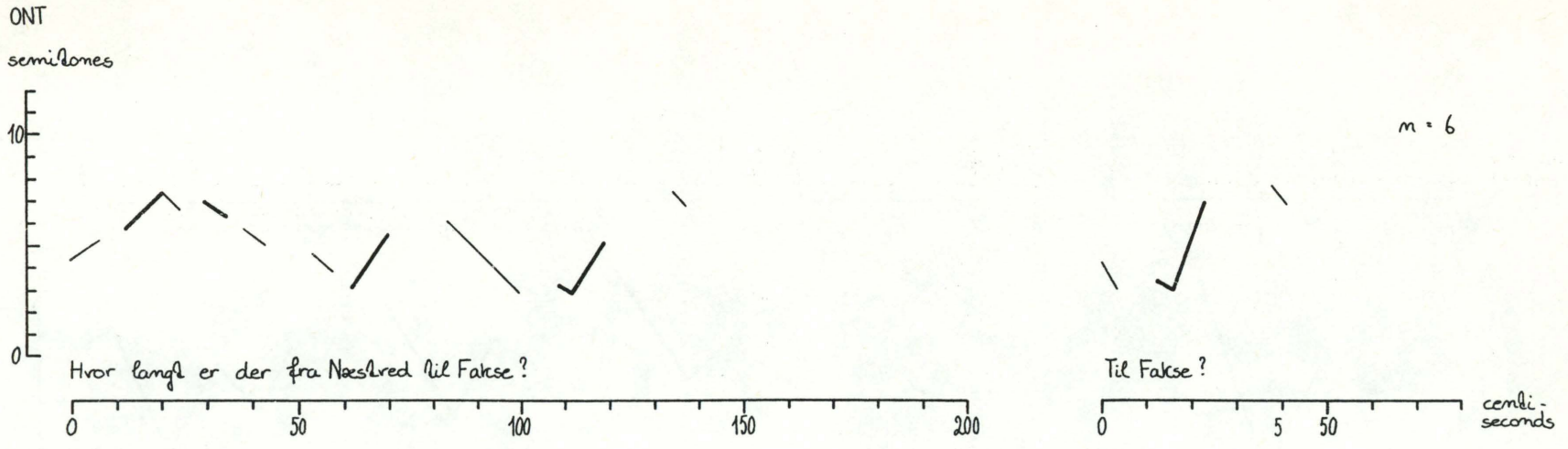

ONT
semitones
10
0
Hvor langt er der fra Næsterød til Falsø?
0
50
100
150
200
n = 6
Til Falsø?
0
5
50
centi-
seconds

Figure 14

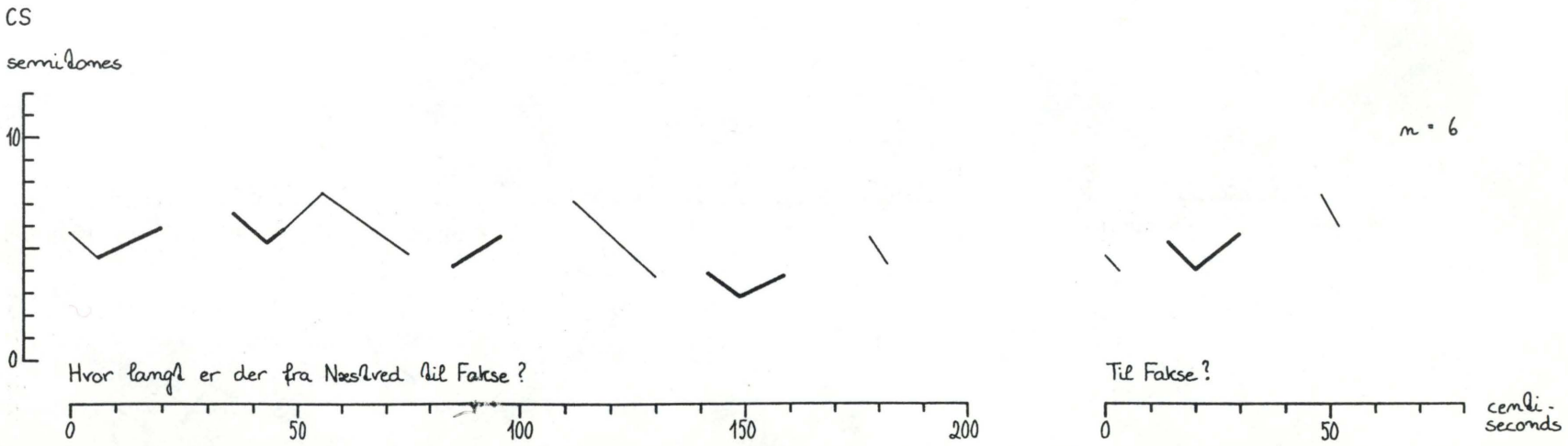

CS
semitones
10
0
Hvor langt er der fra Næstved til Fakse?
0
50
100
150
200
n = 6
Til Fakse?
0
50
centi-seconds

Figure 15

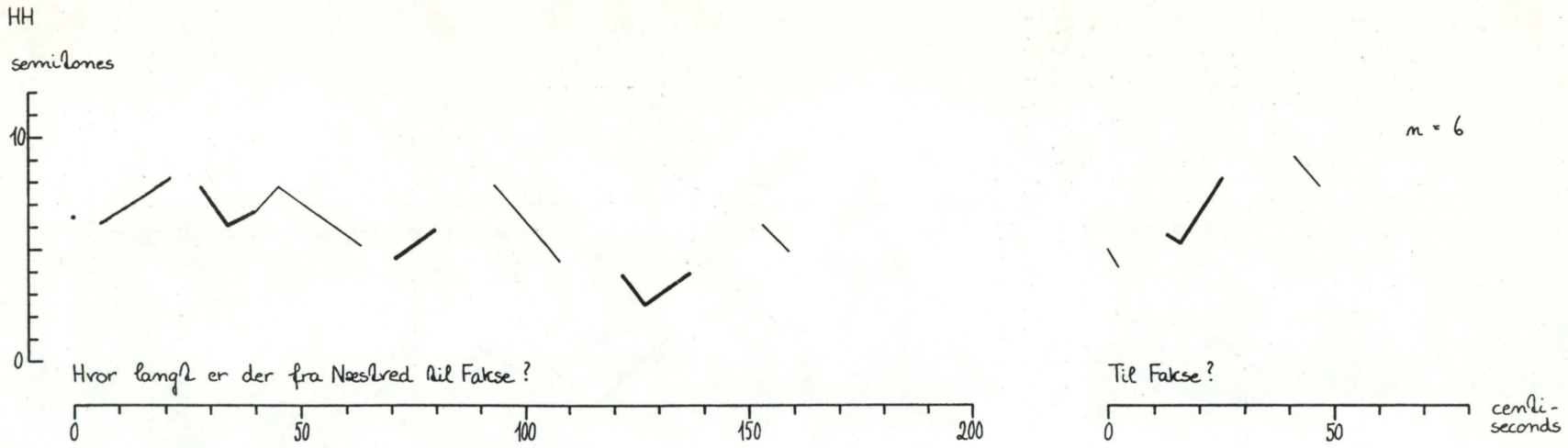

HH
semitones
10
0
Hvor langt er der fra Næsbred til Fakse?
0
50
100
150
200
n = 6
Til Fakse?
0
50
centi-
seconds

Figure 16

in the stressed vowel is higher, onsetting at the same low level as utterance final stress groups in general. The rise from stressed to post-tonic is not higher than in other stress groups and the post-tonic has a falling movement, i.e. again there is no 'final rise' to characterise these echo-questions.

Aalborg and Næstved, both, accordingly correspond exactly to Copenhagen Danish with respect to these types of questions, cf. Thorsen (1978). In fact, the same model for sentence intonation in short utterances could apply to all three regions, presumably. Figure 17 reproduces the model for Standard Copenhagen Danish. Long terminal declaratives also behave similarly, with a reservation about a final, local fall in Aalborg, cf. above. The difference between these regional variants of Standard Danish lies mainly in the way stress and Fo are related, which means that the sentence intonation contour (as defined by the stressed syllables) will be identical to a true topline in Aalborg, i.e. a connection of local maxima in the Fo course; it is often, but not invariably, a baseline in Copenhagen, whereas in Næstved it is, at least acoustically, rather an intermediary between top- and baseline.

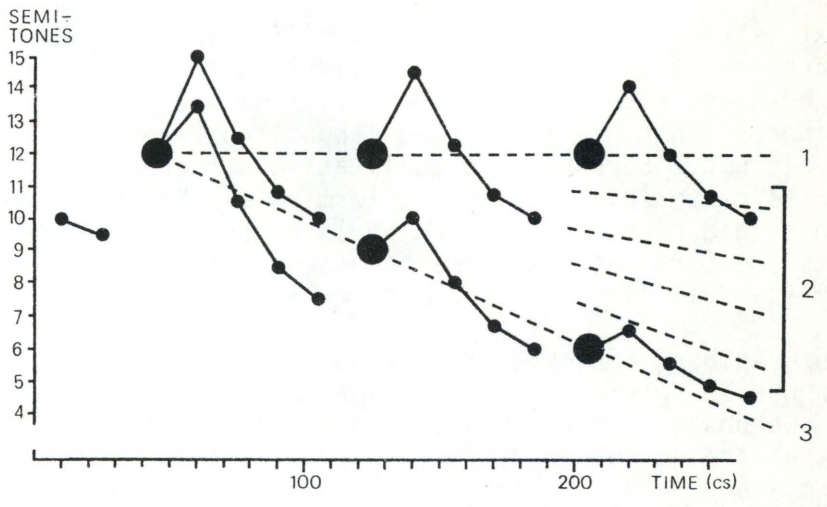


Figure 17

A model for the course of fundamental frequency in short utterances/sentences in Standard Copenhagen Danish. 1: syntactically unmarked questions, 2: interrogative utterances with word order inversion and/or interrogative particle; non-terminal declarative and interrogative sentences (variable), 3: terminal declarative utterances. The large dots represent stressed syllables, the small dots unstressed ones. The full lines represent the Fo pattern associated with prosodic stress groups, and the broken lines denote the sentence intonation contours.

C. ALIGNMENT OF SEGMENTS AND FUNDAMENTAL FREQUENCY

1. Compression or truncation

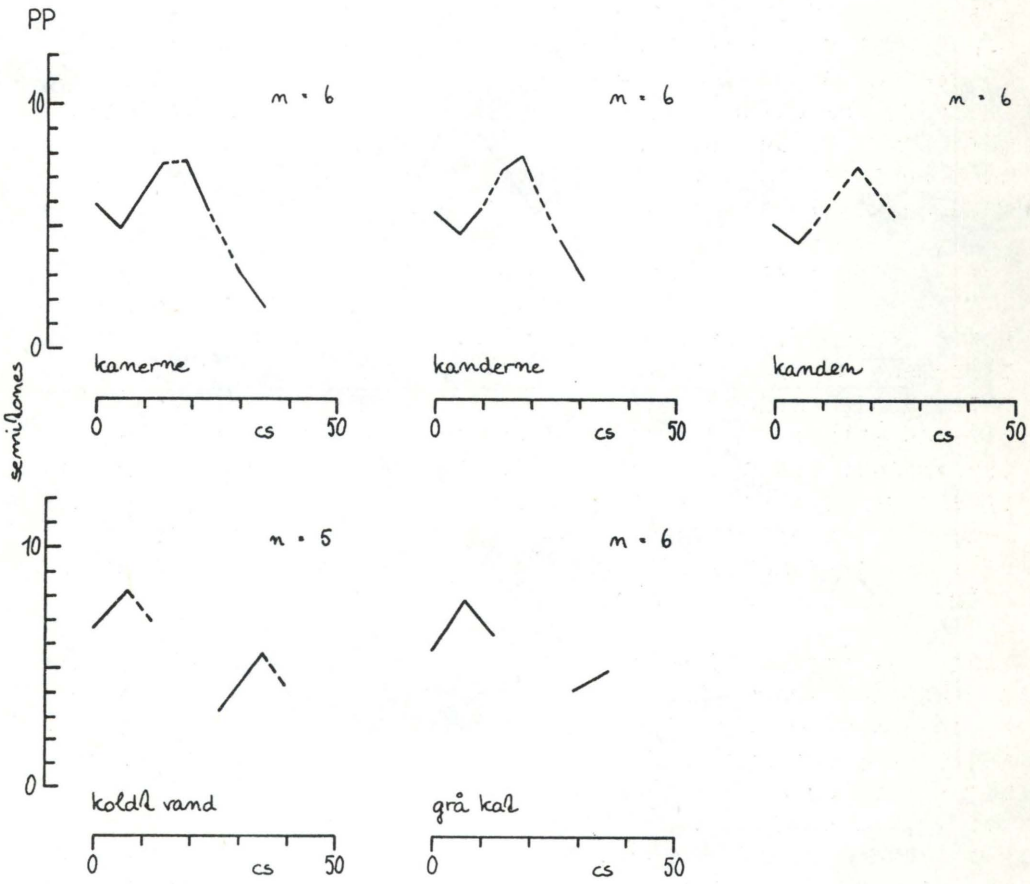
The principal issue here is whether fundamental frequency patterns associated with prosodic stress groups are truncated or compressed in time, when the stress group is shortened.

(a) Aalborg

(i) Systematically shortened stress groups — For an account of the onset of Fo movement in the words displayed in figures 18-20, see this volume, p. 103 ff: I shall assume that the slight falls preceding the rise in the stressed vowel is a segmental effect, and disregard them in the following. It is beyond any doubt that the stress group pattern is truncated as it is shortened in time, as is the case also in Copenhagen, but contrary to the compression that takes place in Bornholm Danish (cf. Thorsen 1984 and this volume, p. 103 ff.) The falling part becomes progressively shorter from fram to frame, and with JW all that remains in the monosyllables is the rise.

(ii) Long stress groups — Figures 21-23 display two rather long stress groups (including the next, stressed, syllable), which differ in the number and placement of word boundaries. Firstly, the pattern already noted above recurs: that the fall from the peak is accomplished within the first (and second) post-tonic and then levels out. Secondly, no qualitative difference between the stress group which begins and terminates mid-word ((fa)brík-ken solgte elektron/ík - broken line) and the one which onsets and terminates at word boundaries (dýbhavsfiskere må/snárt - full line) is apparent.

Thus, Aalborg conforms exactly to the model posed for Copenhagen Danish, where stress group patterns are bound to the left by the onset of the stressed vowel and to the right by the onset of the succeeding stressed vowel, cutting indifferently across any word (or higher syntactic) boundaries (at least within the same sentence intonation contour). (This is not to say that a speaker cannot, if he chooses to do so, signal word boundaries with tonal means, cf. Thorsen 1980a, but in a style of speech which is fluently conversational, as in these recordings, such would be the exception rather than the rule.) The difference lies in the shape of the pattern, and in the alignment of segments and Fo. In Aalborg, the stressed vowel onset defines the beginning of the rise (disregarding segmental effects from preceding consonants), the rise is terminated with the stressed vowel offset, i.e. the high peak, or turning point, generally coincides with the boundary between stressed vowel and postvocalic consonant, if any, although a long vowel may occupy a brief portion of the fall. The fall is steep and low, i.e. it is accomplished through the first, or the first



Figures 18-20

Average fundamental frequency tracings of three words and two pairs of words, where the voiced stretch becomes progressively shorter through the frames, by three Aalborg speakers. When the sonorant consonants could be delimited, they were drawn in broken lines. See further the legend to figures 1-3.

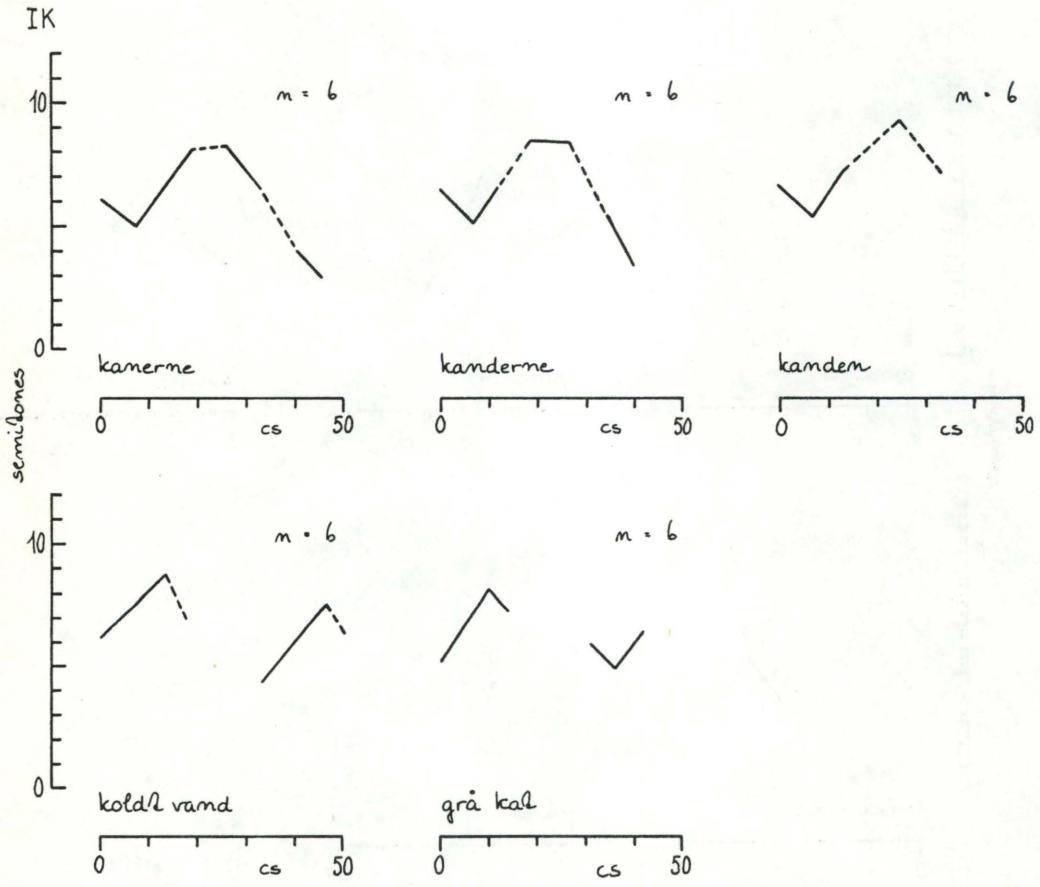

IK
10
0
n = 6
kanerne
0
cs
50
n = 6
kanderne
0
cs
50
n = 6
kanden
0
cs
50
semilunes
10
0
n = 6
koldt vand
0
cs
50
n = 6
grå kat
0
cs
50

Figure 19

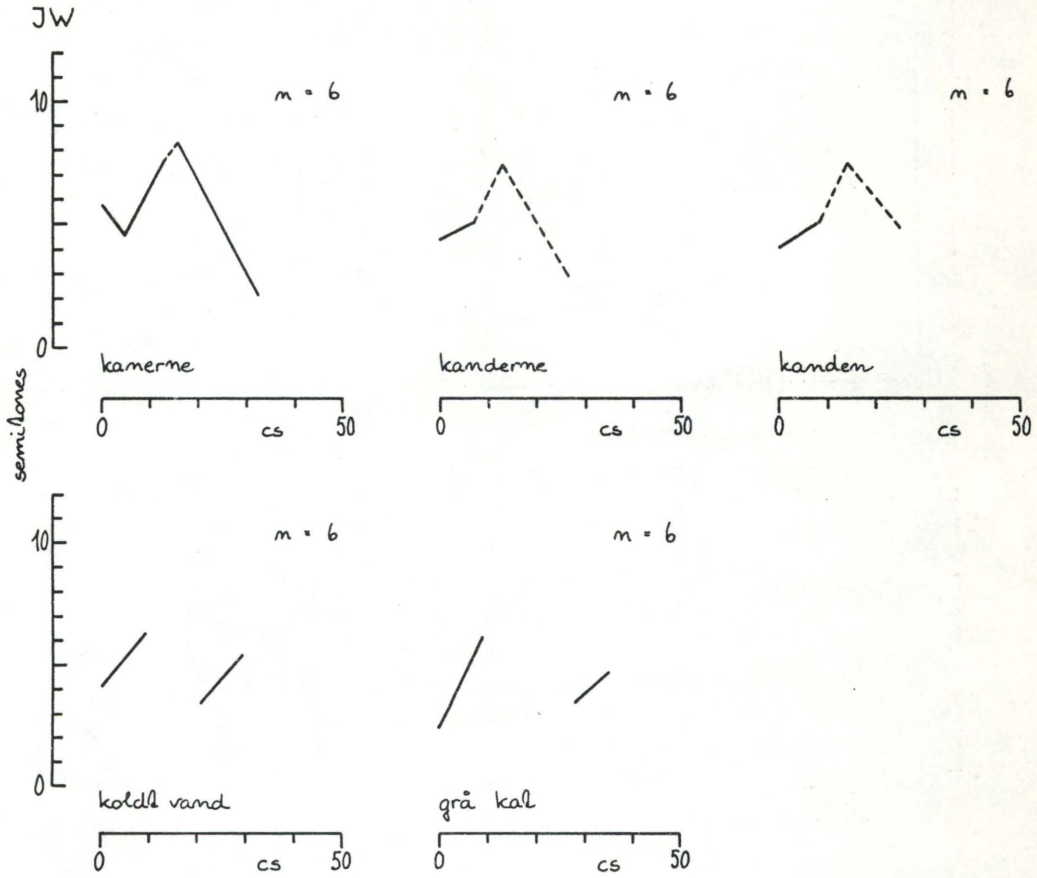

JW
semitones
10
0
n = 6
kamerne
kanderne
kanden
koldt vand
grå kal
0
cs
50

Figure 20

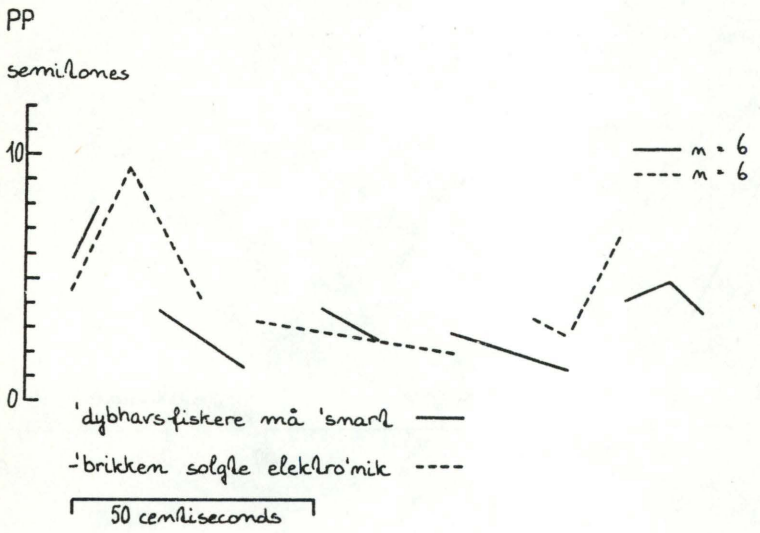


Figure 21-23

Average fundamental frequency tracings of two long stress groups plus the next stressed syllable by three Aalborg speakers. See further the legend to figures 1-3.

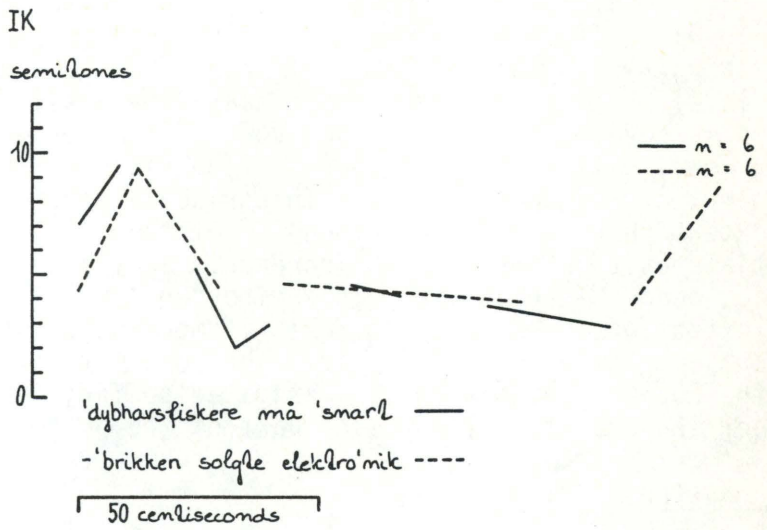


Figure 22

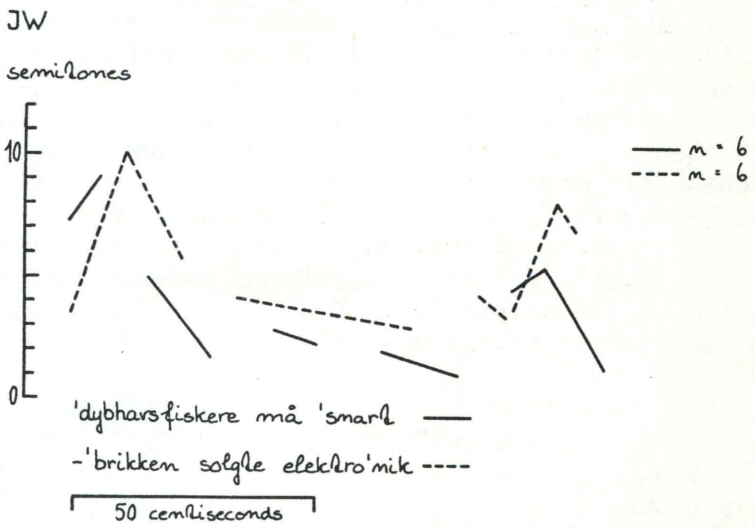


Figure 23

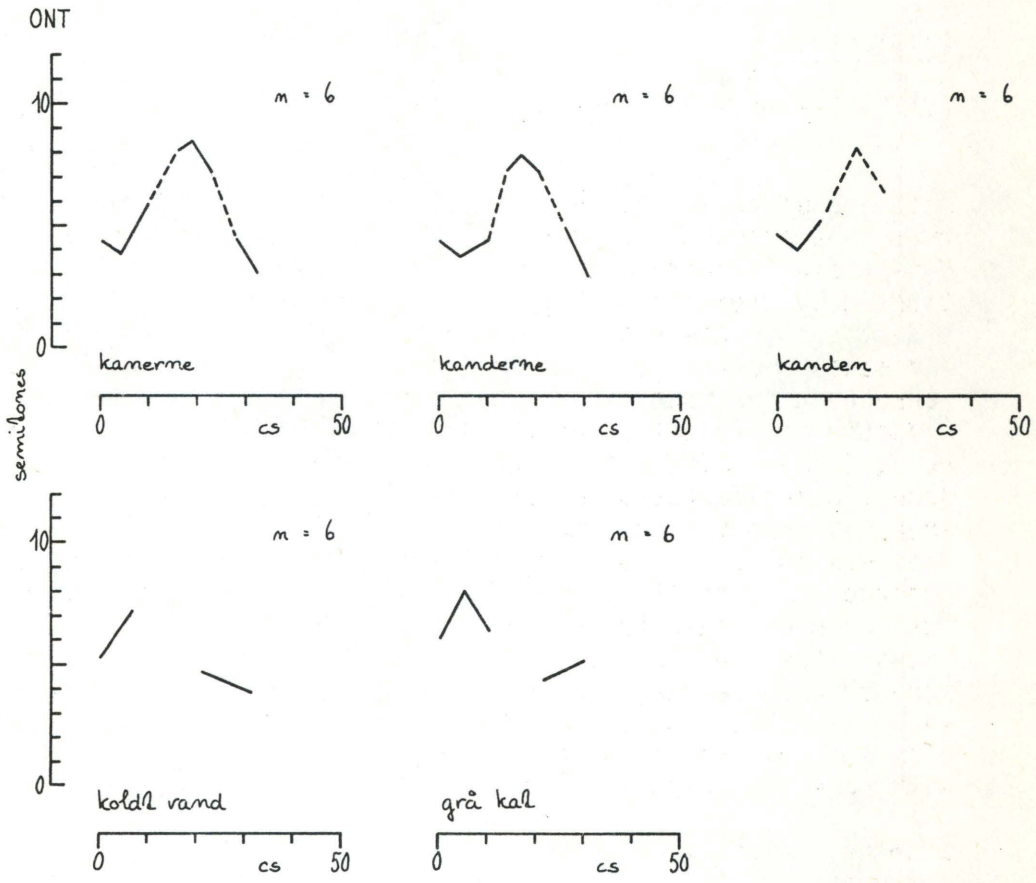
and second post-tonic, after which it levels out. The extent of the falling part of the pattern is somewhat greater than the rise, i.e. a stress group composed of two or more post-tonics will offset at a lower frequency than the onset of the preceding rise. This is very different from Copenhagen (Thorsen 1984) where the pattern is initiated by a slight fall, which is covered by the stressed vowel, if it is short. A long vowel will continue up part of the rising flank of the pattern, cf. figure 30 below. This rise is generally smaller in extent than in Aalborg (around 3 semitones in utterance initial position). Its peak is reached in the first post-tonic, generally (but see further Thorsen 1983c). The slope and extent of the succeeding fall (if more post-tonics follow) is subject to inter speaker variation, but with the majority of the Copenhagen speakers investigated so far, it does not exceed the extent of the rising part of the pattern.

(b) Næstved

(i) Systematically shortened stress groups

Figures 24-28 display the words 'kanerne, kanderne, kanden, kat' from five sepakers, including MC and TJ. The strong stød in this region disrupts the smooth Fo pattern of stød-less strings, either by superposing a sharp drop in Fo (in the "weakest" manifestations), by creating highly irregular (both with regard to periodicity and intensity) vibrations which make the registration and measurement uncertain, or (in its strongest form) by interrupting the vocal fold vibrations altogether. Since the acoustic manifestation of the stød is not the central issue here, I have omitted the stød words from this section. The acoustic manifestation of stød in the rural dialect in the area has been the object of a study by Thomsen (1987). Four speakers follow the pattern outlined already for Aalborg (and Copenhagen): the tail end of the stress group is cut short as the chain of segments is abbreviated. But one speaker, TJ, seems rather to compress his pattern, mainly by performing a steeper rise between the low and high turning points. However, his 'kat' is just as mutilated as with the other speakers, the only remaining movement being a slight fall (and, with some, a subsequent even slighter rise).

I think it safe to conclude, once more, that prosodic stress group patterns, also in Næstved, are truncated rather than compressed, when time is cut short. Thus, the production of stress group patterns need not involve any particular on-line look-ahead which would scan the segmental composition of the stress group in order to align Fo with the segments. Once the pattern is initiated, its course is simply interrupted when no more segments are present to carry it.



Figures 24-28

Average fundamental frequency tracings of three words and two pairs of words, where the voiced stretch becomes progressively shorter through the frames, by five Næstved speakers. When the sonorant consonants could be delimited, they were drawn in in broken lines. See further the legend to figures 1-3.

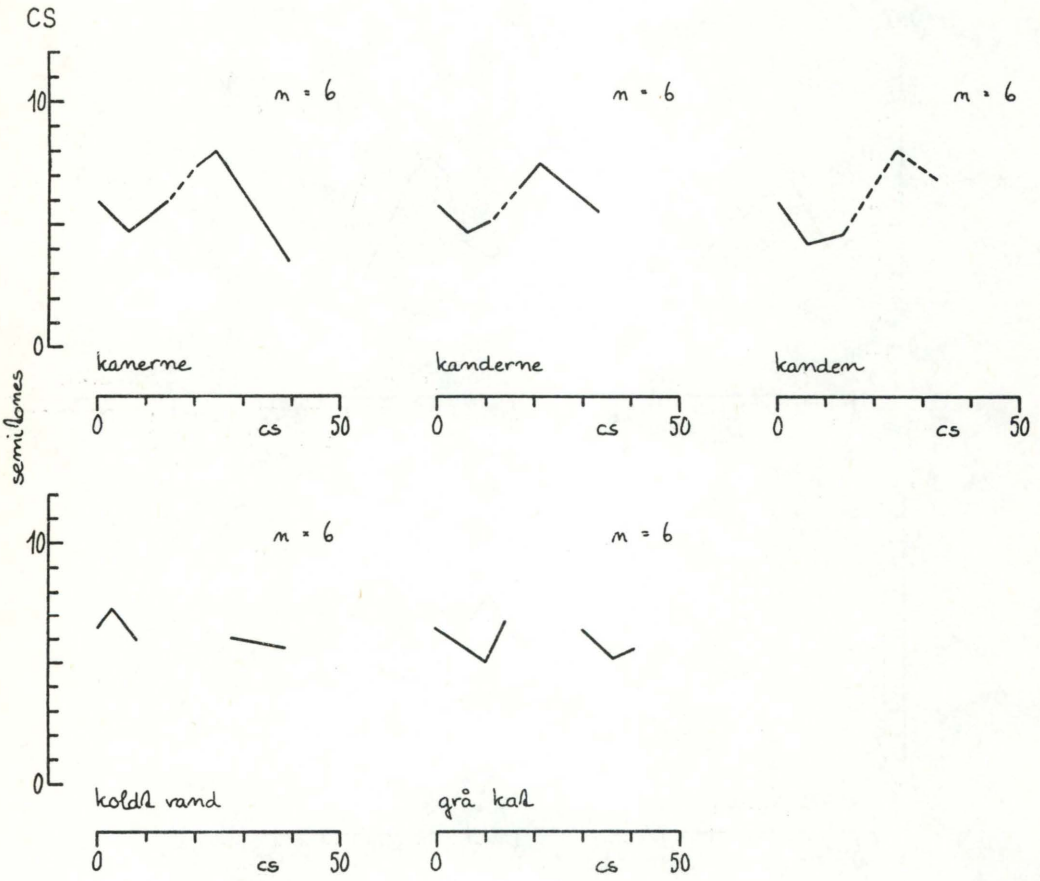

CS
10
0
semilomes
n = 6
kanerne
0
cs
50
n = 6
kanderne
0
cs
50
n = 6
kandem
0
cs
50
n = 6
koldt vand
0
cs
50
n = 6
grå kat
0
cs
50

Figure 25

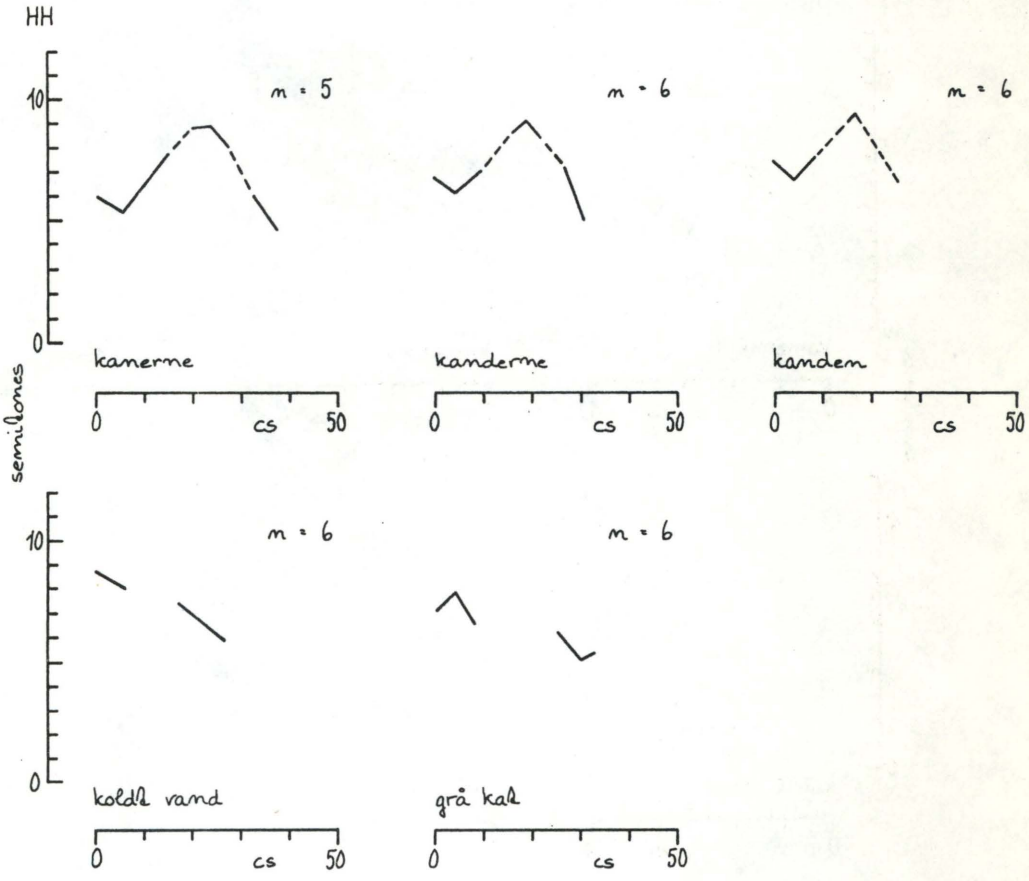

HH
semitones
10
0
m = 5
m = 6
m = 6
kanerne
kanderne
kanden
0
cs
50
m = 6
m = 6
koldt vand
grå kat

Figure 26

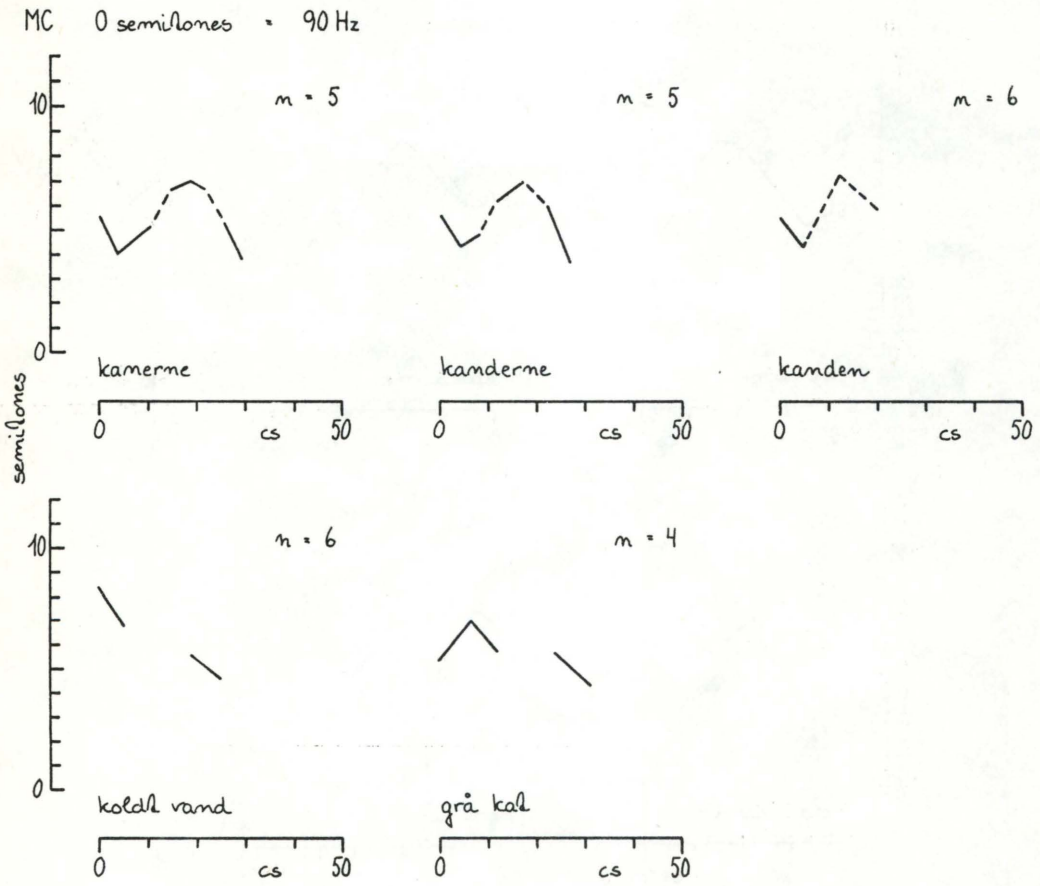

MC 0 semitones = 90 Hz
semitones
10
0
n = 5
n = 5
n = 6
kamerne
kanderne
kanden
0
cs
50
n = 6
n = 4
koldt vand
grå kat

Figure 27

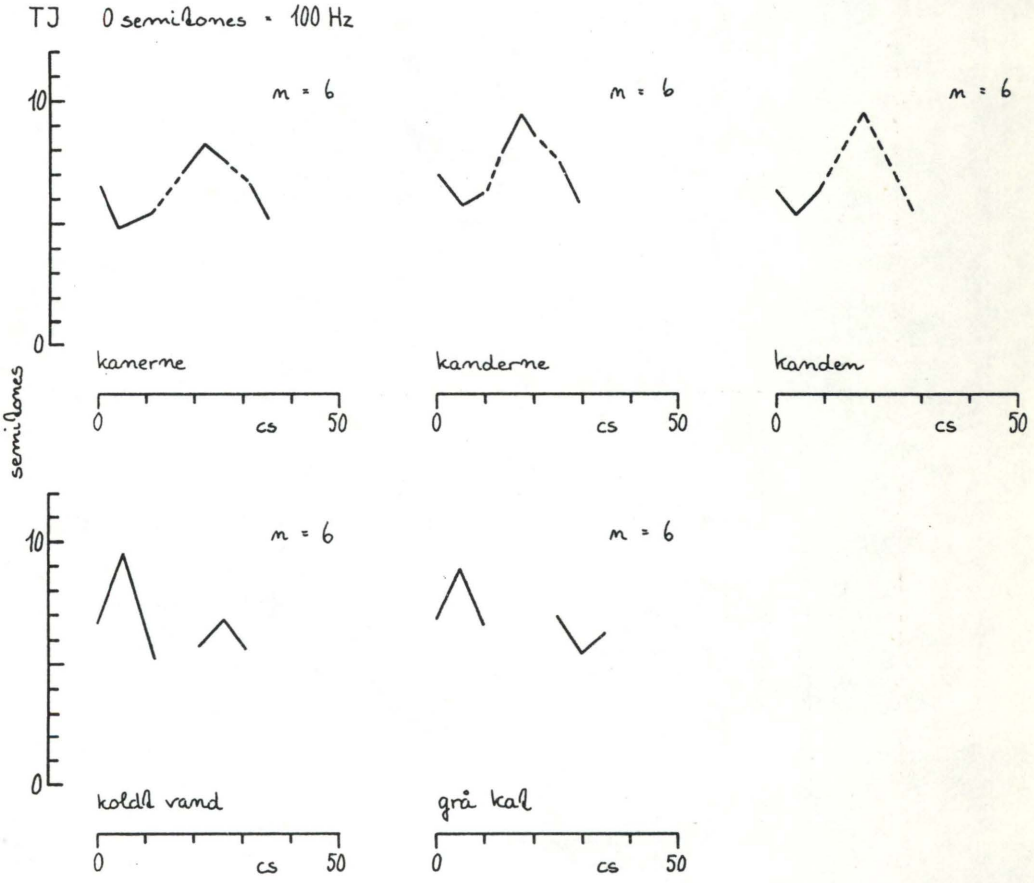

TJ 0 semitones = 100 Hz
semitones
10
0
m = 6
kanerne
kanderne
kanden
koldt vand
grå kal
0
cs
50

Figure 28

(ii) Long stress groups

Figure 29 displays the same patterns as figures 21-23, by one speaker, CS, who epitomizes the behaviour of the group of Næstved speakers. She adds nothing new in principle to what has been observed for Aalborg (and Copenhagen), that word boundaries leave no perceptible trace in the course of Fo. It is very apparent here, that efter the initial rise and (an only slightly more extensive) fall, the pattern levels out, as it does also in Aalborg. This is in contradistinction to the treatment of stress group patterns by Copenhagen speakers, where the slope of the fall through the post-tonics is generally rather more modest, wherefore it may extend over the whole stress group without hitting the floor of the speaker's Fo range. With excessively long stress groups, however, the pattern may either level out at the end or a slight resetting, skip up, may be observed, see further Thorsen (1984).

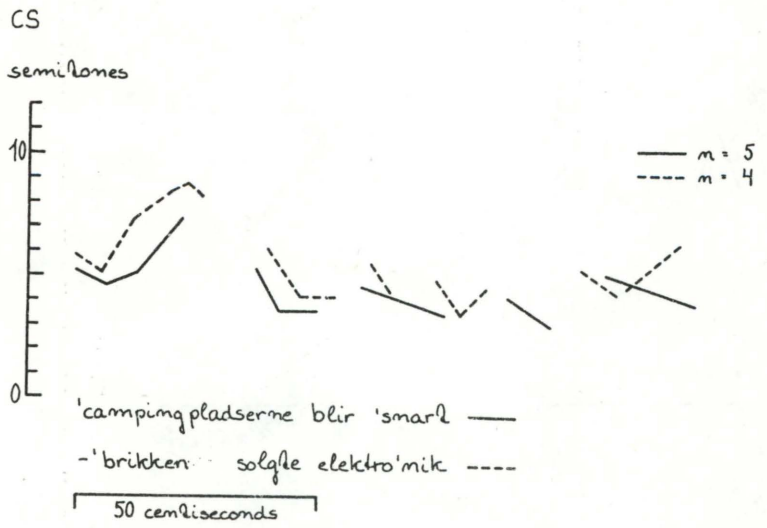


Figure 29

Average fundamental frequency tracing of two long stress groups plus the next stressed syllable by one Næstved speaker.

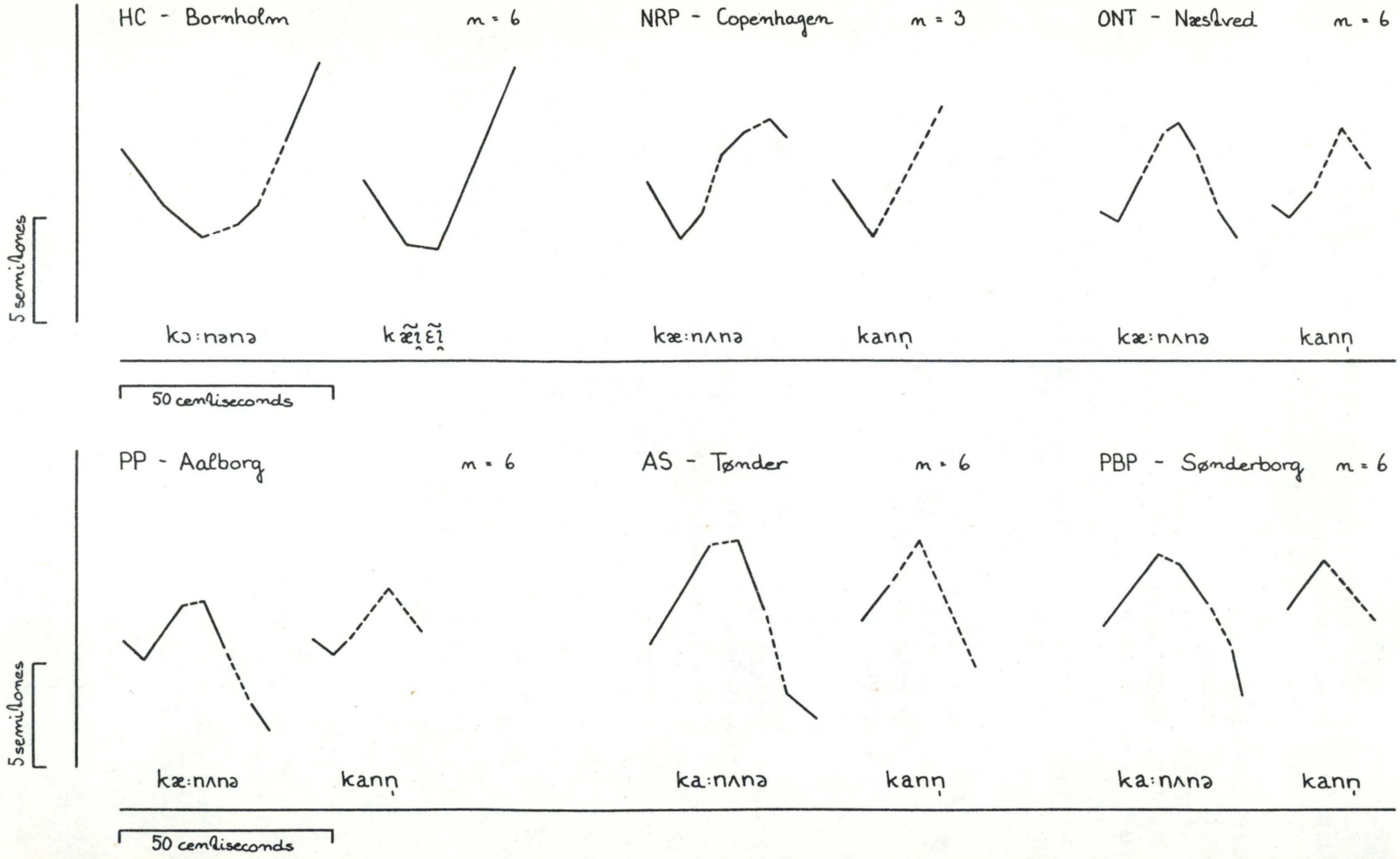


Figure 30

Average fundamental frequency tracings by one speaker from each of six towns of two words which differ in the duration of the voiced stretch. When the sonorant consonants could be delimited they were drawn in broken lines.

(c) Summary

To highlight the differences in the alignment of segments and Fo in the prosodic stress group, figure 30 displays the words 'kanerne' and 'kanden' as produced by one speaker from Bornholm, Copenhagen, Næstved, Aalborg, Sønderborg and Tønder (the complete results of the investigations of the two latter towns will appear in a forthcoming publication). The tracings are arranged from the first to the last speaker according to a scale of "low-high" to "high-low" stress group patterns. Bornholm speakers initiate the pattern with an extensive fall, in time as well as frequency, whose offset generally coincides with the stressed vowel offset (whether it be short or long). The rise is considerable, as high as or higher than the fall, and its peak is timed to coincide with the offset of the last post-tonic syllable. This is the only variety of Danish that I have looked at so far which compresses its Fo patterns. Next is Copenhagen, where the pattern is also initiated with a fall, which is less extensive and much shorter than in Bornholm, and whose offset generally coincides with the short stressed vowel offset. A long vowel will continue up the rising flank. The rise is more extensive than the fall, its peak generally coinciding with the first post-tonic vowel, and it is time constant (for any given speaker, of course - but inter-speaker variation is slight in this respect). If enough segmental material is present, the pattern falls again, a fall whose slope is rather modest (not apparent in this figure), which means that it may continue for the whole extent of the stress group, unless this is really excessively long. The Næstved pattern resembles Copenhagen, except that the stressed vowel is timed somewhat later, i.e. more of the rise is occupied by the stressed vowel, and more so when the vowel is long. The peak is reached with the onset of the first post-tonic vowel, and the fall thereafter is rather steep, but generally only somewhat more extensive than the rise, i.e. it is performed during the first and second post-tonics. Thereafter the pattern levels out (not apparent here). Above, I have termed the Næstved stress group pattern one of the perceptually high-low type. I would like to revise that, and make a distinction between low-high patterns (Bornholm and Copenhagen), low-high-low (Næstved), and the remaining types are then all high-low. Aalborg, Sønderborg and Tønder share the feature that, given enough segmental material, the extent of the fall is considerably larger than the rise. In Aalborg, the extent of the rise is rather small, offsetting with the offset of a long stressed vowel. The succeeding fall is larger than the rise and terminates with the second post-tonic, whereafter the movement levels out (not apparent here). The pattern in Tønder is a clear rise-fall, and even though the rise is not inconsiderable, the fall exceeds it by approximately twice the amount. It is performed within the first and second post-tonics, and then the pattern levels out. I have seen data from two Sønderborg speakers only, so far, and to judge from them, the difference between Tønder and Sønderborg stress group patterns may be that both the rise and the fall are somewhat less extensive and the fall less steep with Sønderborg speakers.

Table III

Differences in duration, in centiseconds, of (parts of) words in utterance final minus utterance initial position, based on averages of six items by each of three speakers from Aalborg and three speakers from Næstved. Differences that are statistically significant (student's one-tailed t-test) are indicated with two or three stars, corresponding to levels of probability of 0.005 and 0.0005, respectively.

		'Kamma'	(tu)rísterne
PP		-0.9	-0.3
IK	*AAL-*		5.2***[4]
JW	*BORG*	6.1***[1]	6.3**[5]
ONT		-1.6	-0.8
CS	*NÆST-*	4.8**[2]	0.9
HH	*VED*	4.2**[3]	-1.0

1) the final vowel is lengthened most (4.6 cs)
2) the stressed vowel is lengthened most (4.4 cs)
3) - - - - - - (3.7 cs)
4) the post-tonic segments are lengthened (6.5 cs)
5) - - - - - (5.7 cs)

D. FINAL LENGTHENING

Due to the rather parenthetical nature of this part of the investigation, this section will be restricted to a mere presentation of the facts. For a thorough treatment of segment duration as a function of context, including references to the existing literature, the reader is referred to Lindblom (1978), and Fischer-Jørgensen (1982). See also this volume, p. 130 ff., for an account of final lengthening in Copenhagen, Bornholm, Malmö and Stockholm.

I have measured each segment in 'Kámma', excluding the closure of the aspirated stop, which cannot be delimited in utterance initial position. I have measured groups of segments in '-rí/st/erne', as indicated by the slants. There are two major segmentation problems: intervocalic /r/ in 'turísterne', which is a uvular approximant or obstruent, and then,of course, the utterance final vowels. The /r/-onset was determined where the intensity curves begin to drop from the preceding vowel. - The final vowels are more cumbersome: they may terminate in weak breathy voice (most often) or in weak unvoiced aspiration. The segmentation which offers the best uniformity across speakers and utterances is a vowel offset coinciding with the point in time where the high-pass filtered intensity curve reaches zero. This corresponds physiologically to the point in time where the vibratory pattern of the vocal cords produces a source funtion wiht little energy in the upper part of the spectrum and where any energy below 500 Hz, which might be produced by 'edge vibrations', is disregarded. Correspondingly, the final vowel in initial words was offset at the point in time where the intensity of the noise of the succeeding fricative (/s, f/) rises sharply ('Kamma stammer fra ..'/'Turisterne fordobler ..').

The results are presented in Table III, where the difference, in centiseconds, of the total duration of the (part of the) word in final minus initial position is given, with footnotes about the distribution of the lengthening in those cases where it is both statistically significant and considerable. Note that there are a number of negative values, i.e. instances where the initial item was longer (though only very slightly) than the final item, ceteris paribus. - No uniform pattern is to be seen. One Aalborg speaker (PP) seems not to have any final lengthening at all, whereas the other two do (there were not enough data from IK on 'Kamma'). Likewise, one Næstved speaker (ONT) does not lengthen his segments in final position, whereas the other two do so, but not consistently, i.e. only in one of the two word pairs. Those lengthenings that are found compare well with what I found for two Copenhagen speakers (this volume, p. 132), and tally reasonably well with Fischer-Jørgensen's (1982) results for Danish, as well. - It seems, in conclusion, that final lengthening is not a stable feature of any of the two regional languages investigated, but further research would be needed into this matter to corroborate this finding.

IV. SUMMARY

The parameters investigated are listed in tabular form below, including the results for Copenhagen, for comparison

	COPENHAGEN	NÆSTVED	AALBORG
SENTENCE INTONATION IS SIGNALLED	globally	globally	globally[1]
DEFAULT SENTENCE ACCENT	no	no	no
FOCAL SENTENCE ACCENT	no	no	no
FOCUS SIGNALLING BY STRESS REDUCTION	optional, never in final position	rare, never in final position	optional, rare in final position
FINAL LENGTHENING	yes	optional	optional

1) though with a possibility of reversing the movement of the final stressed vowel (into a fall) at the end of a long terminal declarative

Apparently, the prosodic systems of Copenhagen, Næstved and Aalborg are very similar. The major difference lies in the tonal pattern associated with the prosodic stress group, cf. above.

V. NOTE

(1) The uncertainty about the degree of stress on 'stammer' is vexing. However, the necessary auditory and acoustic experiments have not been performed which could disclose any difference between a word whose main stress gets reduced in the neighbourhood of a word with focal prominence or emphasis for contrast, and a word with syntactically determined secondary stress in the same condition.

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REFERENCES

Fischer-Jørgensen, E. 1982: "Segment duration in Danish words in dependency of higher level phonological units", *Ann. Rep. Inst. Phonetics, Univ. Copenhagen 16*, p. 137-189

Fretheim, T. 1988: "'Broad focus' and 'narrow focus' in Norwegian intonation", unpublished manuscript, Dept. of Linguistics, Trondheim University

Ladd, D.R. 1978: *The Structure of Intonational Meaning - Evidence from English*, Indiana University Press, Bloomington

Lindblom, B. 1978: "Final lengthening in speech and music", in *Nordic Prosody I* (eds. E. Gårding, G. Bruce and R. Bannert), Dept. of Linguistics, Lund University, p. 85-101

Thomsen, O.N. 1987: *Kortvokalstødet i sjællandsk - Det sjællandske kortvokalstøds fonologi og fonetik med særligt henblik på dets akustiske manifestation*, unpublished thesis

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

Thorsen, N. 1980a: "Word boundaries and Fo patterns in Advanced Standard Copenhagen Danish", *Phonetica 37*, p. 121-133

Thorsen, N. 1980b: "Neutral stress, emphatic stress, and sentence intonation in Advanced Standard Copenhagen Danish", *Ann. Rep. Inst. Phonetics, 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*, p. 302-216

Thorsen, N. 1983a: "Standard Danish sentence intonation - Phonetic data and their representation, *Folia Linguistica 17*, p. 187-220

Thorsen, N. 1983b: "Two issues in the prosody of Standard Danish", in *Prosody: Models and Measurements* (eds. A. Cutler and D.R. Ladd), Springer, Heidelberg, p. 27-38

Thorsen, N. 1983c: "The tonal manifestation of Danish words containing assimilated or elided schwa", in *Nordic Prosody II* (eds. C.-C. Elert, I. Johansson and E. Strangert), Almqvist & Wiksell, Stockholm, p. 215-230

Thorsen, N. 1984: "Variability and invariance in Danish stress group patterns", *Phonetica 41*, p. 88-102

Thorsen, N. Grønnum 1985: "Intonation and text in Standard Danish", *J. Acoust. Soc. America 77*, p. 1205-1216

Thorsen, N. Grønnum 1986: "Sentence intonation in textual context - supplementary data", *J. Acoust. Soc. America 80*, p. 1041-1047

Thorsen, N. Grønnum 1987: "Intonation and text in Standard Danish - with special reference to the abstract representation of intonation", in *Phonologica 1984* (eds. W.U. Dressler, H.C. Luschützky, O.E. Pfeiffer and J. Rennison), Cambridge University Press, p. 301-309

Thorsen, N. Grønnum 1988: "Intonation on Bornholm - between Danish and Swedish", this volume p. 25-138

INSTITUTE OF PHONETICS
JANUARY 1, 1987 - DECEMBER 31, 1987

I. PERSONNEL OF THE INSTITUTE

PROFESSOR:
Jørgen Rischel, dr.phil.

ASSOCIATE PROFESSORS:
Børge Frøkjær-Jensen, cand.mag. (seconded to the Audiologopedic Centre)
Peter Holtse, cand.phil. (from April 1st)
Birgit Hutters, cand.mag.
Niels Reinholt Petersen, cand.phil.
Nina Grønnum Thorsen, lic.phil.
Oluf Thorsen, cand.mag.

RESEARCH FELLOWS:
Jan Leon Katlev, lic.phil. (until January 31st)
Peter Molbæk Hansen, cand.mag.
Peter Holtse, cand.phil. (until March 31st)

ENGINEERS:
Otto Bertelsen, M.Sc.
Preben Dømler, B.Sc.

TECHNICIAN:
Svend-Erik Lystlund

SECRETARY:
Else Parkmann

GUEST RESEARCHER:
Eli Fischer-Jørgensen, dr.phil.h.c.

II. PUBLICATIONS BY STAFF MEMBERS AND GUESTS

Niels Bak and Preben Dømler: "The relation between blowing pressure and blowing frequency in clarinet playing", Acustica 63, 238-241

Eli Fischer-Jørgensen: "Segment duration in Danish words: Dependency on higher level phonological units", in: In honor of Ilse Lehiste (edited by R. Channon and L. Shockey), Foris Publications, Dordrecht, 51-73

Birgit Hutters and Kirsten Brøndsted: "Strategies in cleft palate speech - with special reference to Danish", Cleft Palate Journal 24/2, 126-136

Björn Granström, Peter Molbæk Hansen and Nina Thorsen: "A Danish text-to-speech system using a text normalizer based on morph analysis", European Conference on Speech Technology (edited by J. Laver and M.A. Jack), CEP Consultants, Edinburgh, vol. 1, 21-24

Jørgen Rischel: "Phonetic transcription in fieldwork", Zeitschrift für Dialektologie und Linguistik (Beihefte - edited by A. Almeida and A. Braun), Heft 54, 57-77

Jørgen Rischel: Sproggranskeren Rasmus Rask, Odense Universitetsforlag, 45 pp.

Jørgen Rischel: "Sprogforskeren Rasmus Rask 200 år", in Humanist, University of Copenhagen, fasc. 14, 3-4

Jørgen Rischel: "Some reflexions on levels of prosodic representation and prosodic categories", in Nordic Prosody IV (edited by K. Gregersen and H. Basbøll), Odense University Press, 3-30

Jørgen Rischel and Søren Egerod: "'Yumbri' (Phi Tong Luang) and Mlabri", Acta Orientalia 48, 19-33

Søren Egerod and Jørgen Rischel: "A Mlabri-English vocabulary", Acta Orientalia 48, 35-88.

Nina Grønnum Thorsen: "Intonation and text in Standard Danish - with special reference to the abstract representation of intonation", in Phonologica 1984 (edited by W.U. Dressler et al.), Cambridge University Press, 301-309

Nina Grønnum Thorsen: "Text and intonation - a case study", in Nordic Prosody IV (edited by K. Gregersen and H. Basbøll), Odense University Press, 71-79

Nina Grønnum Thorsen: "Suprasegmental transcription", Zeitschrift für Dialektologie und Linguistik (Beihefte - edited by A. Almeida and A. Braun), Heft 54, 79-109

Ole Kongsdal Jensen and Oluf Thorsen: Fonetik for Franskstuderende, 2. oplag, Romansk Institut, København, 212 pp.

III. GUEST LECTURES AND SEMINARS

March 11 - Eli Fischer-Jørgensen: Fonetisk analyse af stødet i dansk rigsmål.

March 31 - Ailbhe Ní Chasaide (Trinity College, Dublin): Perception of pre-aspiration.

April 24 - Christine Shadle (University of Southampton): Models of sound generation mechanisms in fricative consonants.

May 5 - Christer Gobl (Royal Institute of Technology, Stockholm): Röstkällans egenskaper vid normal fonation.

September 25 - Lennart Nord (Royal Institute of Technology, Stockholm): Akustiska studier av nasalitet i normalt, patologiskt och syntetiskt tal

and Akustiska studier av vokalkvalitet i svenskan.

October 30 - Karoly Galyas (Royal Institute of Technology, Stockholm): Att kommunicera med syntetiskt tal.

November 6 - Mats Blomberg (Royal Institute of Technology, Stockholm): Segmentering och igenkänning av tal.

November 17 - Klaus Kohler (University of Kiel): The influence of microprosody (Fo and phonation type) on segment perception.

IV. PARTICIPATION IN CONGRESSES, ETC.

Eli Fischer-Jørgensen participated in the XIth International Congress of Phonetic Sciences, Tallinn 1-7 August as invited speaker for the opening session.

Birgit Hutters participated in the International Voice Symposium, Broxburn, Scotland, 12-14 August.

Peter Molbæk Hansen participated in two COST 209 Working Group meetings, in Rome May 12-13 and in Espoo, Finland, October 7-8.

Jørgen Rischel and Nina Thorsen participated in a Seminar at Stockholm University in April about phonetics/phonology. Jørgen Rischel gave an introductory lecture.

Nina Grønnum Thorsen participated in the European Conference on Speech Technology, Edinburgh September 2-4.

Nina Grønnum Thorsen gave four guest lectures in Sweden: "Bornholmsk intonation - mellan svenskan och danskan" at Stockholm University February 11, at Uppsala University February 12, at Umeå University Frebruary 23, at Lund University March 6.

Nina Grønnum Thorsen gave a guest lecture at the Catholic University of Nijmegen, "Synthesizing Danish intonation", December 2.

V. INSTRUMENTAL EQUIPMENT OF THE LABORATORY

The following is a list of instruments that have been purchased or built during the period January 1 - December 31, 1987.

INSTRUMENTATION FOR SPEECH ANALYSIS

1 light source, Olympus, type CLV
1 fiberscope, Olympus, type ENF-10
1 video camera, Olympus, type OTV-F

TAPE RECORDERS

1 instrumentation recorder, Brüel & Kjær, type 7006

MICROPHONES

1 microphone, Sennheiser, type MKE 2-6

OUTFIT FOR PHOTOGRAPHY

1 enlarger, Durst, type 707
1 exposure system, Durst, type DES 100
1 colorprocessor, Jobo, type CPP-2 + lift.

EQUIPMENT FOR EDP

1 computer, Regnecentralen, type RC 900
1 printer buffer, Trend, type 710E
1 graphics display, Masscomp, type Aurora
1 modem, Gaia, type 1200
1 printer, Printstar, type 5025
1 laserprinter, Hewlett-Packard, type II.