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INTONATION CONTOURS IN DECLARATIVE SENTENCES OF VARYING LENGTH IN ASC DANISH[1]

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1. Introduction

The stress/Fo relationship and the intonation contours of various types of short sentences in Advanced Standard Copenhagen (ASC) Danish have been described elsewhere (Thorsen 1978a, 1979b). For the purpose of the present paper, only a few points need be repeated: Stress in ASC Danish is signalled mainly by Fo. In neutral speech a stressed syllable will be (relatively) low and followed by a high-falling tail of unstressed syllables, i.e. the stressed syllable is one that is jumped or glided up from, depending on the segmental composition, cf. Fig. 1 (full lines). The unit which carries this Fo pattern consists of the stressed syllable plus all succeeding unstressed ones, irrespective of intervening syntactic boundaries within the simple (i.e. non-compound) sentence. It is termed a stress group (SG). Since the Fo patterns of SGs are predictable and recurrent entities (though allowing for certain context dependent modifications), the intonation contour may be defined solely in terms of the stressed syllables. (This does not necessarily mean that the course of the unstressed syllables is irrelevant, e.g. for the perception of intonation contours but it is, strictly speaking, redundant, cf. Thorsen 1978b.)

In simple sentences having no more than three SGs, the intonation contours were found to approach straight lines whose slopes varied according to sentence type. Declarative sentences have the most steeply falling contours at one extreme and syntactically unmarked questions have "flat" contours at the other. In between are found various syntactically marked questions as well as non-

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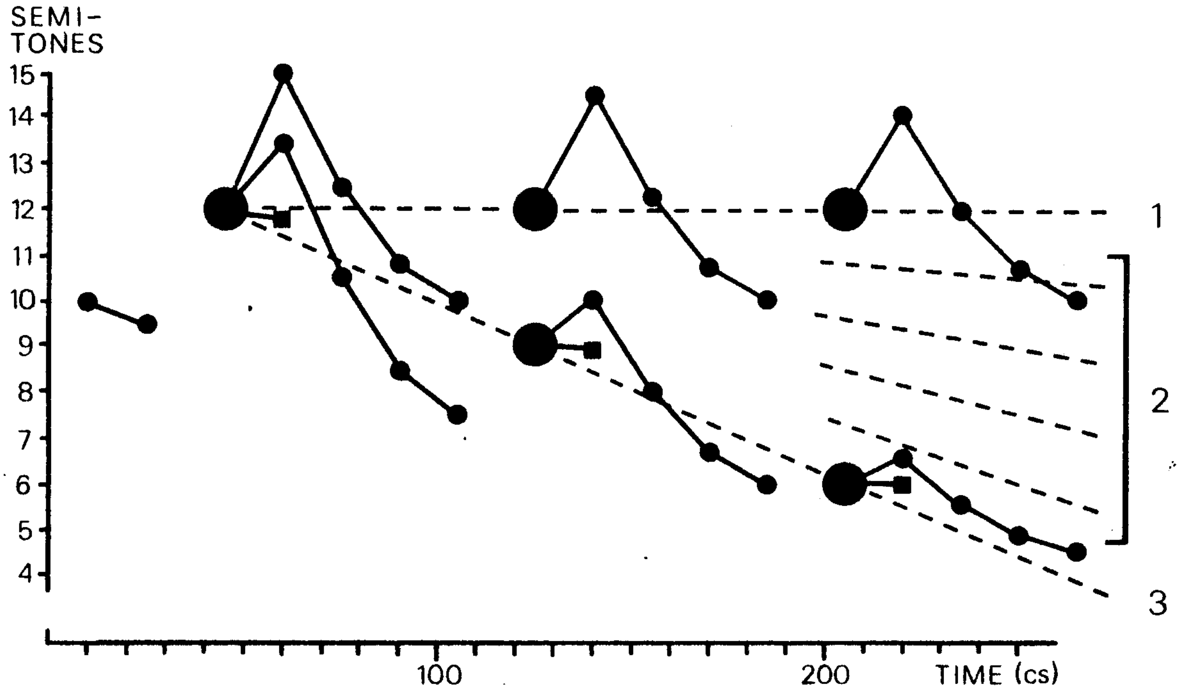


Figure 1

A model for the course of Fo in short sentences in ASC Danish.
1: syntactically unmarked questions, 2: interrogative sentences with word order inversion and/or interrogative particle, and non-final periods (variable), 3: declarative sentences. The large dots represent stressed syllables, the small dots unstressed ones, and the small squares represent an unstressed syllable being the only one between two stressed ones. The full lines represent the Fo pattern associated with stress groups, and the broken lines denote the intonation contours.

final clauses, with a tendency for the contour to be steeper, the more syntactic information is contained in the sentence about its interrogative or non-final function, cf. Fig. 1 (broken lines).

2. The present experiment

Thorsen (1979b) hypothesized that when the number of SGs changes, everything else being equal, so does the slope of a given contour, leaving only the flat ones intact. The constancy presumably lies in the interval between first and last stressed syllable, intervening stressed syllables being evenly distributed between them. (A similar hypothesis is advanced for Swedish, cf. Bruce 1979.) Since declarative sentences have the widest range, differences in slope would be most easily detected in them: eight simple statements were made up, containing from one to eight SGs, all variations on the same theme. They may be deducted from the longest one, though some of the names were moved about for the sake of variety (´ denotes the stressed syllables and | denotes the syntactical boundaries between NP and VP, VP and compound adjunct, and the two adjuncts):

$\overset{2}{\text{Hútters}}$ (og $\overset{8}{\text{Bítten}}$) | $\overset{2}{\text{skal}}$ (med $\overset{3}{\text{bússen}}$) | $\overset{1}{\text{til}}$ ($\overset{5}{\text{fésten}}$)
(for $\overset{6}{\text{Kísser}}$) (og $\overset{7}{\text{Líssi}}$) | $\overset{5}{\text{på}}$ ($\overset{4}{\text{Kílden}}$ i) $\overset{1}{\text{Thísted}}$.

(Hutters and Bitten are taking a bus to the party for Kisser and Lissi at Kilden in Thisted.) To get sentence no. X, pick out all words from left to right numbered X and lower. The stressed vowels are all short, high (except [ɛ] in 'festen'), and surrounded by unvoiced obstruents (except [ɪ] in 'Lissi') to facilitate the subsequent interpretation of the tracings (cf. Thorsen 1979a).

The items were mixed with a material recorded for a different purpose, being evenly distributed over two full pages of recording material, which appeared in three different randomizations, each being read twice, giving a total of six recordings of each sentence. Subjects were four phoneticians, three ASC speakers (NRP male, BH female, NT female (the author)) and one with a slightly more conservative pronunciation (JR male).

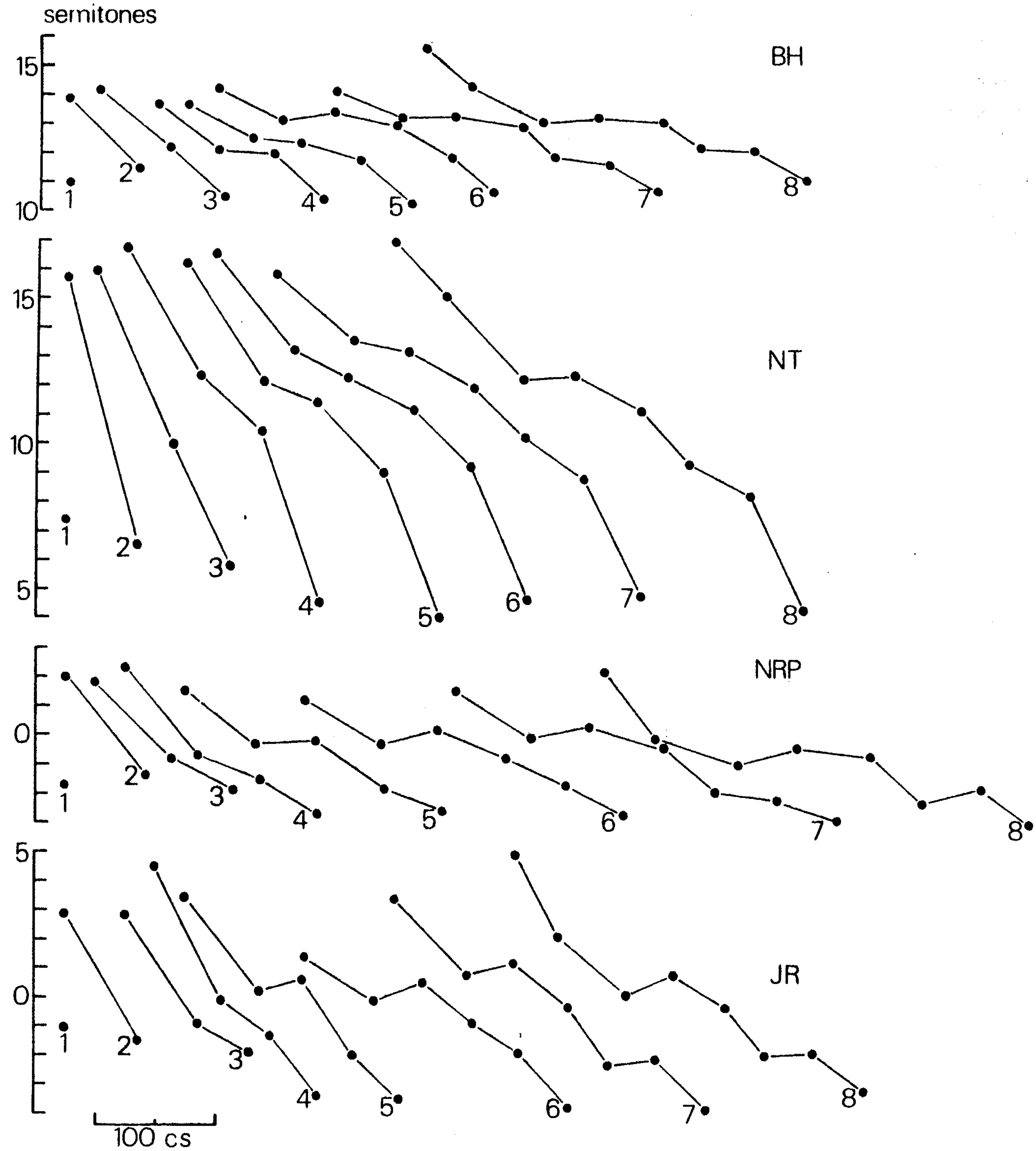
The recordings were made with semi-professional equipment in a quasi-damped room and were processed by hard-ware intensity and pitch meters, registered on a mingograph and measured by hand. Fo of each of the stressed vowels was measured at 2/3 of the distance in time from vowel onset (cf. Rossi 1971) which was an uncontroversial procedure since the vowels all had monotonously falling movements. The distance in time of each of these points from the first vowel Fo was also measured. The average Fo measurements were then converted to semitones (re 100 Hz) and a correction made for intrinsic Fo level differences between [u], [ɛ], and [i], in accordance with Reinholt Petersen's (1978) results.

3. Results

The results are displayed graphically in Fig. 2. In Table 1 are given the slopes of the intonation contours, as determined by the least squares linear regression on the data points in Fig. 2, their correlation coefficients, and the interval between first and last vowel (range).

First of all, range is not constant throughout the eight sentences with any subject but neither is it monotonously increasing with increasing number of SGs and there is no clear relationship between (smaller) range and (greater) size or number of breaks in the contours. The inconstancy of the range is also reflected by the fact that the regression line slopes, although they do get less and less steep, do not do so in even approximately equal size steps through sentences 2 to 8 - even though the time increments are very nearly constant.

Secondly, the intonation contours are obviously not straight lines, but the correlation coefficients are generally above .95 and any further statistical treatment will hardly disclose the regularities that can be observed in Fig. 2 any more succinctly than visual inspection will do: The medial stressed vowels do not occur with equal intervals and the irregularity generally sets in with four and more SGs. With BH, NRP and JR, the longer utterances seem to be composed of two (sentences 4-6) and three (7-8) prosodic phrase groups, respectively, the breaks between which coincide with major syntactical boundaries, viz. before the (compound)



<u>Figure 2</u>

Intonation contours in simple declarative sentences containing from one to eight stress groups.

Table 1

Intonation contour slopes (semitones/sec), correlations between the time and Fo measurements, and ranges (semitones) for sentences 8-2.

Sen-tence no.	BH Slope/corr.	BH range	NT Slope/corr.	NT range	NRP Slope/corr.	NRP range	JR Slope/corr.	JR range
8	-1.16/ -.95	4.5	-3.20/ -.97	12.6	-1.09/ -.89	5.2	-2.42/ -.95	8.1
7	-1.20/ -.97	3.5	-3.23/ -.96	11.0	-1.26/ -.96	4.4	-2.66/ -.97	7.3
6	-1.37/ -.93	3.6	-4.00/ -.96	11.9	-1.31/ -.95	3.9	-2.14/ -.94	5.2
5	-1.66/ -.96	3.5	-5.26/ -.97	12.2	-1.81/ -.97	4.1	-3.66/ -.97	6.9
4	-2.21/ -.96	3.3	-7.14/ -.98	12.2	-2.95/ -.97	5.0	-5.61/ -.98	7.9
3	-3.57/-1.00	3.7	-8.96/-1.00	10.1	-3.31/ -.98	3.7	-4.82/ -.98	4.8
2	-4.50	2.4	-15.11	9.2	-5.10	3.4	-7.24	4.4

adjunct and between what might be termed the adjunct of purpose and the adjunct of place. BH differs slightly from NRP and JR in the way the prosodic phrase group boundaries are realized. Incidentally, the rises from one group to another exhibited by NRP and JR are not indicative of a sentence accent or the like: all the utterances were perfectly neutral and contained no perceptual trace of extra prominence anywhere. - NT (the author) has a much wider range than the others and comes rather close to the hypothesis of constant range and equal intervals, but also with her there are discontinuities in the contours, coinciding with the boundaries.

4. Discussion

The purpose of the investigation was not to investigate the interplay between syntax and intonation as such. Nevertheless, the tendencies that emerge raise some interesting questions concerning the hierarchy and domain of syntactic boundaries vs. the inherent features of declarative intonation. In this material, the boundary before the (compound) adjunct seems to be more manifest than the NP-VP boundary. Further, 4 SGs in the prosodic phrase group seems to be the maximum (cf. sentences 6-7). The constituent which was varied most in number of SGs was the adjunct. What would the contours have looked like if instead the NP and/or

VP had varied? E.g. is the rather steep slope in the first gradient an inherent feature of declarative intonation or an artefact of the material that would disappear if the NP or VP were longer? With a short adjunct but long NP, would a break occur after the NP and would the VP and adjunct merge into one prosodic phrase group? If the second of the two adjuncts had consisted of only one SG, would it have had to merge with the preceding adjunct in order to preserve a final fall? (and where would the first adjunct be cut up then, if 4 SGs are the maximum in a prosodic phrase group?), or is the final fall dispensable as long as there is a general downdrift as observed in the material? In other words, is overall downdrift the only requirement to be filled in declarative sentences (a downdrift whose slope will be a function, although not a linear one, of the total duration of the sentence)? These, and a heap of other questions, are good candidates for further research.

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