STANDARD DANISH INTONATION[*]

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INTRODUCTION

By intonation I mean speech melody, i.e. the fundamental fre-
quency (F_0) variation as it appears in F_0 curves from (analog
or digital) frequency analysers. Other phenomena which in lin-
guistic 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, be-
cause this allows you to single out the parameter under scru-
tiny without interference from other factors which may in-
fluence F_0. Secondly, you may reasonably expect that natural,
spontaneous speech can be described, at least to a certain ex-
tent, 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 param-
eters will have to be supplemented.

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 bound-
aries between two main clauses and between verb phrase and
complement within each clause; + denotes prosodic stress group
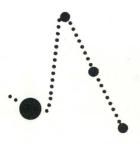boundaries, and ΄ marks the stressed syllables):

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

Han + lágde sig på chaise + lóngen og + tǽndte
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 syl-
lable 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
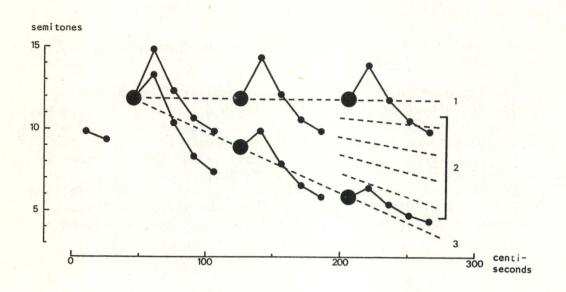sequences below are all realized with the same F_0 pattern:

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 be-
tween 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 bound-
aries, 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 investiga-
tions of timing.

semi tones

Figure 1

A model for the course of fundamental frequency in
short sentences in Standard Danish. (1) Syntactical-
ly 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 quant-
itative variation, depending on

(1) its position in the utterance (the magnitude of the rise
     from stressed to post-tonic syllable decreases from be-
     ginning 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 de-
     gree 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 ma-
terial 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
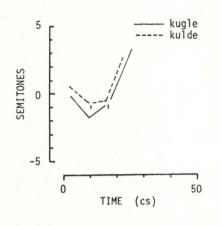the falling unstressed syllables. See further Thorsen 1984a
and 1984b.

gruppering / opstilling

ALIGNMENT OF SEGMENTS WITH F_O PATTERNS

It is implicit in what has been said above, that Danish re- *ligner*
sembles the other Germanic languages where stress is con-
cerned. I.e. stressed versus unstressed is a meaningful
opdeling i to 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 assim-
ilates 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_O. See further Brink and Lund
1975 and Thorsen 1984a. (This rather drastic phonetic reduc-
tion - compared to the full underlying forms (and the ortho-
graphical representation) - contributes much to make Danish
difficult to understand for Swedes and Norwegians, in spite
of the obvious similarities between the Scandinavian lan-
guages.)

Danish has a phonological distinction in stressed syllables
between long and short vowels, without the complementary con-
sonantal length, characteristic of Standard Swedish and Nor-
wegian. Stressed syllables also carry a phonologically rele-
vant stød/non-stød distinction, corresponding to the word
tone distinction of Swedish and Norwegian. However, the mani-
festation 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
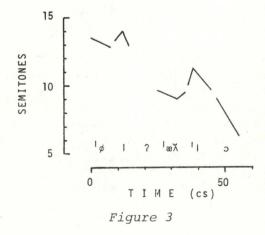underlying lexical forms (cf. Basbøll 1972 and Rischel 1969).

To the extent that stød has an influence upon the course of
F_O it will generally introduce a local falling tonal movement.
Stress has a much more invariable and considerable effect upon
F_O, 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 co-
incide 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_O 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 re-
cordings) of two utterance medial words kugle and
kulde [ǧʰu.1, ǧʰull]. 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. ['øl ?'æʌ 'lɔ]. The initial [l] in 'lúnken' be-
haves 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 differ-
ences between the [l] and the vowels, because, if anything,
the consonant has an intrinsically lower F_0.) In fact, the
initial [l] in 'lúnken' behaves qualitatively exactly as the
final [l] in 'øl'. Its more ample rising movement is due to
the longer total duration of the sequence [æˆl] 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 V̌C-V̌ rather than V̌-CV̌,
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 dura-
tion cues are ambiguous, the frequency location of the [l] alone
can shift listeners' identification of synthetic stimuli be-
tween /'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 con-
sonants 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 seg-
mental duration indicates a boundary between a prevocalic con-
sonant 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 compensa-
tion 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 dia-
lects, 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 Zea-
land demonstrates rather radical differences from Standard
Danish. However, this presentation will burst at its seams if
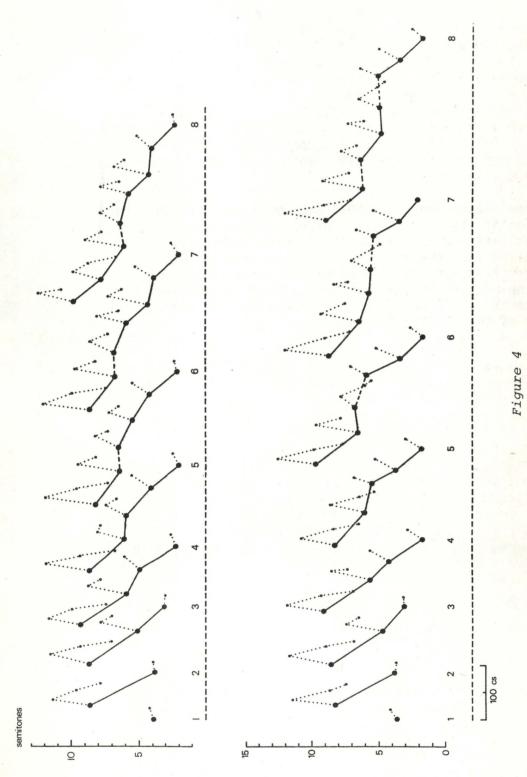it is not restricted to Standard Danish.
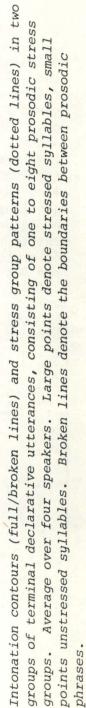
SENTENCE INTONATION CONTOURS

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 de-
fined in terms of the stressed syllables alone (which is en-
tirely 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 inter-
rogative or non-terminal function of the sentence, the more
falling, i.e. the more terminal declarative-like, is the into-
nation 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 con-
stituents. 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 declina-
tion - 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 syn-
tactic structure. That is, prosodic boundaries will be
affiliated (but not coterminous) with syntactic ones (pro-
sodic 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.
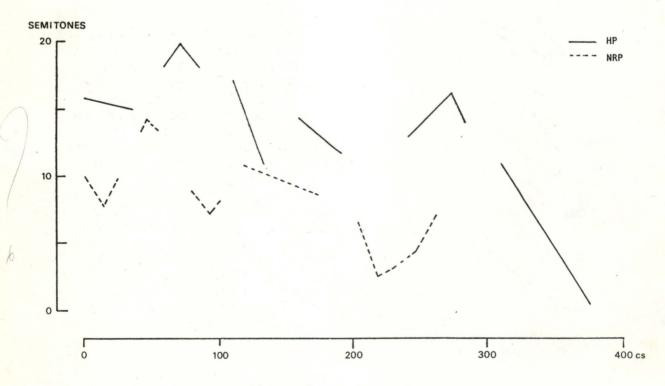
the length of the syntactic constituents in the utterance
while taking into account their semantic content), but syntac-
tic boundaries, inversely, need not leave any trace in the
intonational structure of syntactically unambiguous, non-
compound sentences. Whether syntactic boundaries can be traced
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 im-
plies 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 move-
ment 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, where-
as 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 utter-
ance. (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 con-
siderable 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,
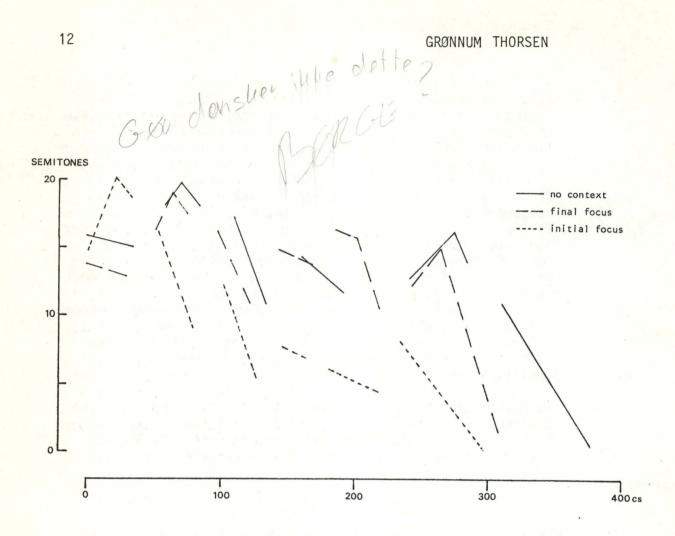will deviate in the same manner that Bornholm does.

SENTENCE ACCENT

Standard Danish displays yet another peculiarity: it lacks an
obligatory sentence accent, or focus, or nucleus. In pragmat-
ically 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 aver-
aged 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 re-
played 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 con-
ditions in the acoustic registrations, nor to auditorily

Gør dansker ikke dette?
Borge?

SEMITONES

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
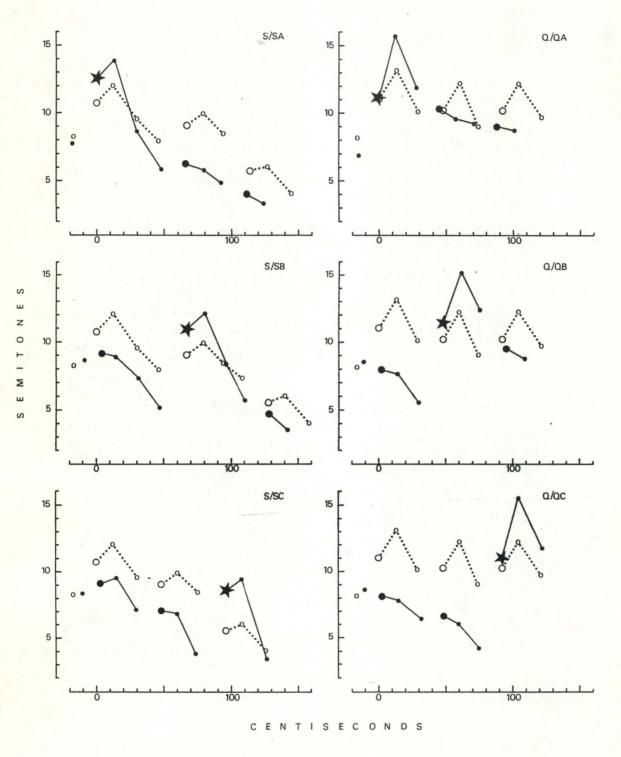semitones corresponds to 70 Hz.*

determine the context from which the (different) statements
were taken, when replayed in isolation.) - Note that the prin-
cipal 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 pat-
tern terminates higher than 'Kamma' in the neutral utterance,
lower in the edition with focus on 'Kamma', besides a differ-
ence 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

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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

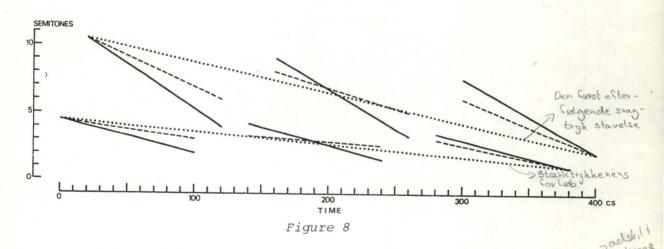*Stylized tracings of the course of F_O in statements (S - left) and questions (Q - right), which are prosodically neutral (open circles and dotted lines) or have emphasis for contrast (stars, points and full lines) in initial position (top), medial position (mid) and final position (bottom). Stars denote 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 pro-
sodically 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 perceptual-
ly salient feature of contrast emphasis resides in the shrink-
ing 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 necessari-
ly syntactically coordinated sentences.) Figure 8 summarizes
the analysis of texts consisting of one, two, or three sen-
tences. These sentences were semantically coherent (they de-
scribed what various members of a family were doing during their
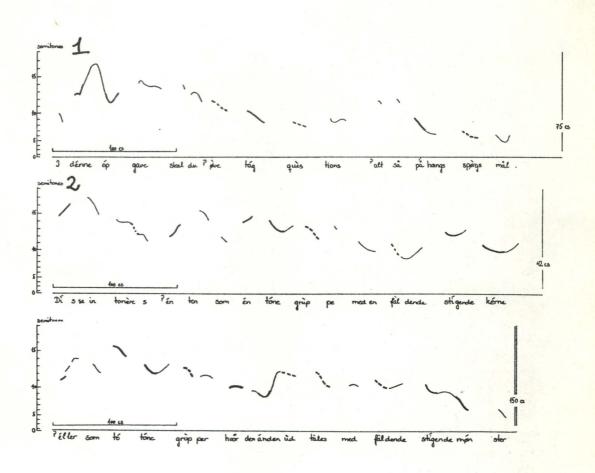summer holidays). In one set of texts they were syntactically

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 syl-
lable 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 Tysk-
land.' (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 (dis-
regarding 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 *begyndelse*
and offset of upper and lower lines, respectively, decrease
gradually through the text. Furthermore, the different syn-
tactic arrangement is reflected in a difference of subordina-
tion 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 sen-
tences 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 sen-
tence 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 prag-
matically 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 system-
atic 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 syl-
lable to the post-tonic is not the only cue to its stressed-
ness. (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 syl-
lables may determine a syllable as stressed. That is, if a
syllable falls into place in a rhythmic pattern and an intona-
tional 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 char-
acterization 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 distinc-
tion 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 normally
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 ac-
cent before. In retrospect, the behaviour of stressed syl-
lables surrounding an emphasis for contrast could have pro-
voked 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 secon-
dary 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 ex-
periments, before the descriptive categories can be definitive-
ly 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 iden-
tical across Danish, Swedish, German and English, namely text,
utterance (sentence), phrase, foot or stress group, and syl-
lable. (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 simul-
taneous 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.

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