ACOUSTIC-PHONETIC INVESTIGATIONS OF THE INTONATION OF GERMAN AND DANISH: SIMILARITIES AND DIFFERENCES*

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INTRODUCTION

The past ten years have witnessed a growing interest in prosodic studies - phonological as well as phonetic ones. Today the emphasis is on the construction of theories and on empirical investigations, which interact and lead to models of prosody.

We present here the results of instrumental phonetic investigations of German and Danish intonation and account for the prosodic categories required in the description. This is followed by a comparison of the two languages, insofar as the prosodic categories and their manifestation is concerned. The presentation is descriptive rather than arguing. Discussions about intonation theories and models can be found in Bannert (1982) and Thorsen (1983a, 1983b, 1985a, 1985b). Our purpose here is to present to the reader the basic structures of German and Danish intonation and point out the more important similarities and differences. Such descriptions and comparisons may serve as point of departure for further comparative studies and for foreign language teaching. We would like to stress the fact at the outset that the research we each of us have conducted was not intended for comparative (Danish-German) purposes, and this paper thus represents a "rationalization after the fact". That also accounts for the somewhat different disposition of the two sections, which excludes a direct comparison of every aspect treated in Danish and German, respectively.

TERMINOLOGY AND PROCEDURES

By intonation we mean speech melody, i.e. the fundamental fre-
quency (F_0) variation or pitch course as it appears in F_0
curves. Other phenomena which in linguistic tradition are oc-
casionally encompassed by intonation such as rhythm and voice
quality, will not be dealt with here.

Our results derive from systematic, empirical and experimental
acoustic investigations. Such investigations have certain in-
trinsic limitations. They often deal with sentences which
have been read by speakers in sound treated rooms. Such is
also the case here. The material is often composed of severe-
ly limited and manipulated utterance types. Such a procedure
may seem inappropriate in view of the fact that the final goal
is a description of the intonation of spontaneous speech. How-
ever, our methods may be defended on at least two grounds.
Firstly, it is easier to investigate the course of Fo in syn-
tactically and pragmatically simple structures which have been
produced under controlled circumstances. Secondly, you may
expect that natural, spontaneous speech can be described with
the same categories and prosodic structures as manipulated,
read sentences. In other words, the intonation of non-mani-
pulated, free speech will later be accounted for with the same
descriptional devices as the controlled speech situation. The
description of intonation in both languages is based on sen-
tences of varying length and encompasses declarative as well
as interrogative utterances.

THE BASICS OF DANISH INTONATION

The model in figure 1 derives from analyses of fairly short,
simple sentences, read aloud by speakers of Copenhagen Standard
Danish. The pragmatically neutral context as well as instruc-
tions to the speakers were intended to elicit neutral speech,
i.e. speech which is not characterized by any particular emo-
tions or emphases.

The model depicts the structure of intonational phenomena as
a hierarchically organized system, where components of smaller
temporal scope are superposed on components of larger temporal
domain. In other words: global tendencies with more local
modifications. For Standard Danish the following components
can be discerned:

The text contributes an overall textual contour.
The sentence yields a sentence intonation contour.
The prosodic phrase adds a phrasal contour.
The prosodic stress group[1] contributes a stress group pattern.
The "stød" may involve a tonal modification on the stress
group pattern.
Finally, individual segments have intrinsic Fo characteristics
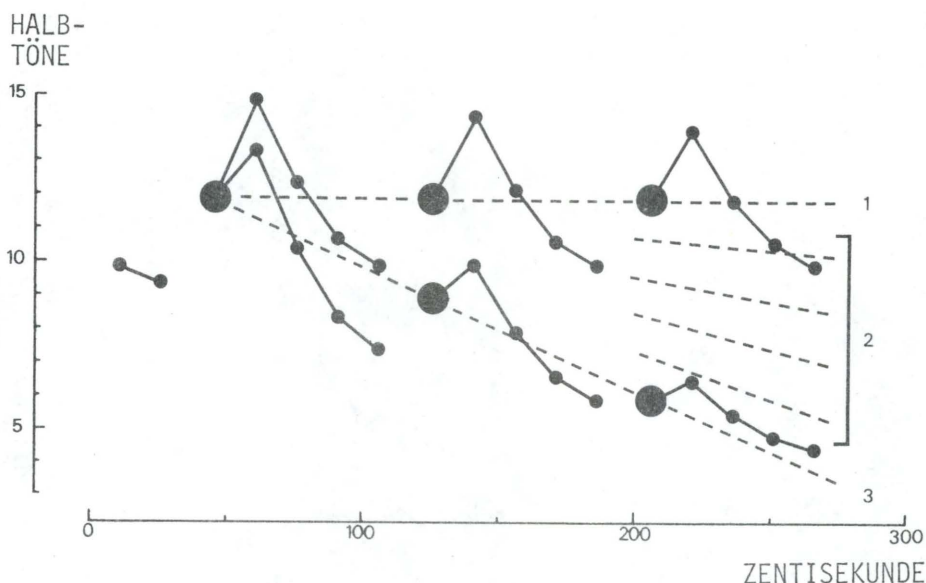(the microprosodic component).

HALB-
TÖNE

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 stres-
sed syllables, small points depict unstressed syl-
lables. Full lines represent the Fo pattern of pro-
sodic stress groups; broken lines indicate the sen-
tence intonation contours.*

Figure 1 only depicts the sentence and stress group components.
If the utterance exceeds a certain length, the intonation con-
tour is decomposed into shorter, falling phrasal contours,
which together describe an overall falling contour (figure 2,
see also Thorsen 1983a, 1983b). Sentences are coupled together
into coherent texts in a similar fashion. Each sentence has
its own intonation contour, but together these sentences de-
scribe an overall falling course (see figure 3 and also Thorsen
1985a, 1985b). In the following, only the sentences and stress
group components are dealt with.

The prosodic stress group

Basbøll (1977) defines a syntactic stress group in Danish as a
group of words with one main stress which lies on the last word
in the group (with certain exceptions: personal pronouns are
unstressed also in final position). The prosodic stress group,
on the contrary, consists of a stressed syllable and all suc-
ceeding unstressed syllables, i.e. the prosodic stress group
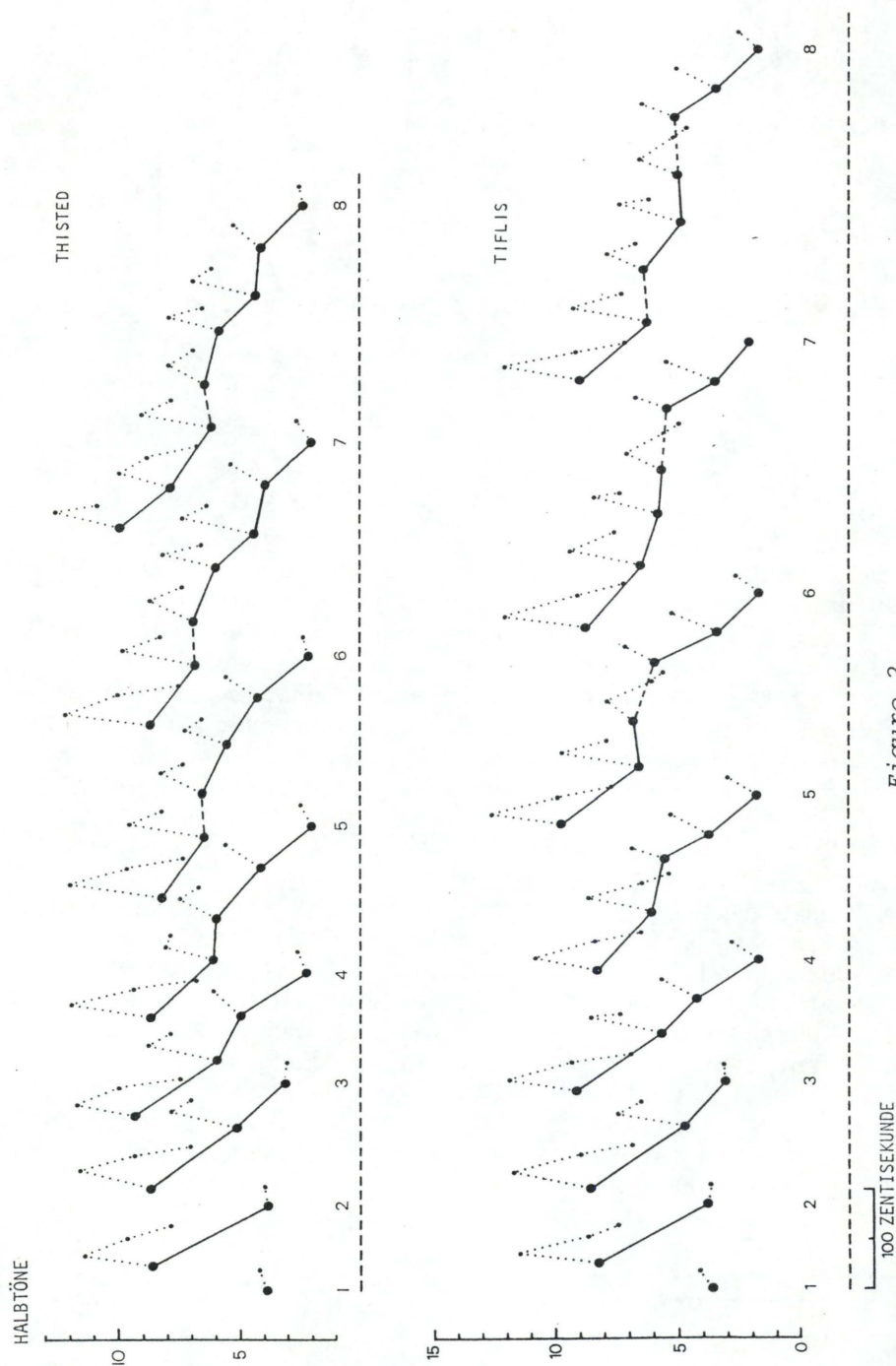boundary, or foot boundary, lies immediately before the stressed

Figure 2

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.
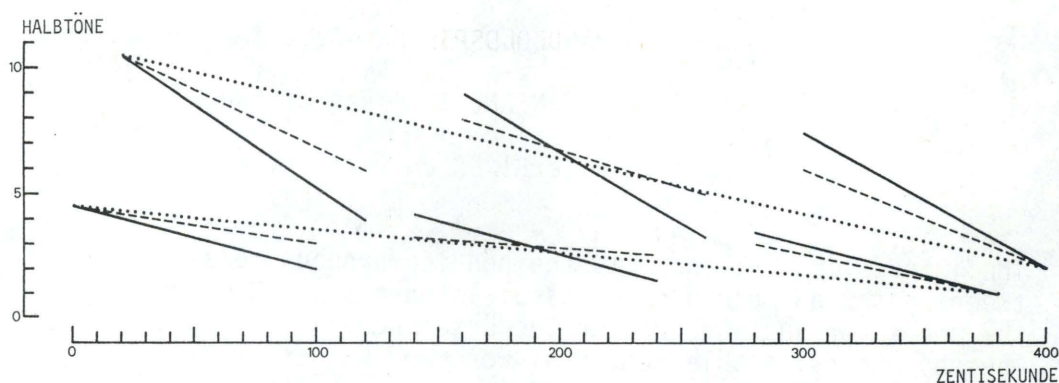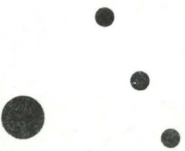
Figure 3

*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 repre-
sent 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.*

syllable, independently of the number and type of syntactic
boundaries in the sentence. 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 ˆ 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 re-
curring and fairly constant Fo contour consisting of a (rela-
tively) low stressed syllable followed by a high-falling tail
of unstressed syllables. Thus, the three capitalized sequences
below are all realised with the same Fo pattern:

HÅNDBOLDSPIL ER méget ánstrengende

baNÁNERNE I kássen er rådne

allerGÍ ER EN INfám sýgdom

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 Fo. (This is true at
least of the type of monitored and fluently read speech which
is the basis for the analysis.)

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 syl-
lable may be higher than, on a level with, or lower than the
stressed syllable, depending on how many unstressed syllables
precede.

Stress group pattern variation

The prosodic stress group pattern is subject to a certain quan-
titative variation, depending on
1) its position in the utterance (the magnitude of the rise
   from stressed to post-tonic syllable decreases from begin-
ning to end)
2) the intonation upon which the pattern rides (the rise is
   higher on less falling contours, cf. figure 1).

Furthermore, the number of unstressed syllables in a prosodic
stress group may vary between zero and rather large numbers,
which naturally influences both the Fo pattern and the time
interval between the stressed syllables. If there are no un-
stressed syllables in the stress group, there is no material
on which the pattern can rise (and fall), so the Fo pattern
is truncated (rather than being compressed in time to be con-
tained 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 (1984).

The slope of the intonation contour

When the stress group pattern is a recurrent, predictable,
qualitatively constant LOW + HIGH-FALLING pattern, the intona-
tion contour can be defined in terms of the stressed syllables
alone. That is not to say that the course of the unstressed

syllables is irrelevant for the identification of intonation contours, only that they are redundant in the strict sense of the word (see further Thorsen 1980a). In short utterances the intonation contours approach straight lines whose slopes vary in close correlation with the type and function of the utter- ance, 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 and 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 declarative-like, is the intonation contour, and vice versa. Furthermore, it appears that, just like in German, the tonal course is the same in utterances with identical pro- sodic structure, independently of syntactic constituents. See also above under "The prosodic stress group".

Longer utterances

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 (figure 2). The boundaries between prosodic phrases in an utterance are re- lated, though not directly subordinated, to syntactic boundaries. The relationship between utterance length, prosody, syntax and semantics is rather complex. See further Thorsen (1983a).

Global signalling of sentence intonation

The description of intonation above implies that sentence intona- tion is signalled globally rather than locally, i.e. the differ- ence between, e.g., a declarative and interrogative sentence does not reside in a special movement at the end of the sentence but is distributed over the whole utterance. In this matter, Danish is different from most of the related Germanic languages.

Sentence accent

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 unnatural and they are very easy to elicit in re- cordings. See further Thorsen (1983b).
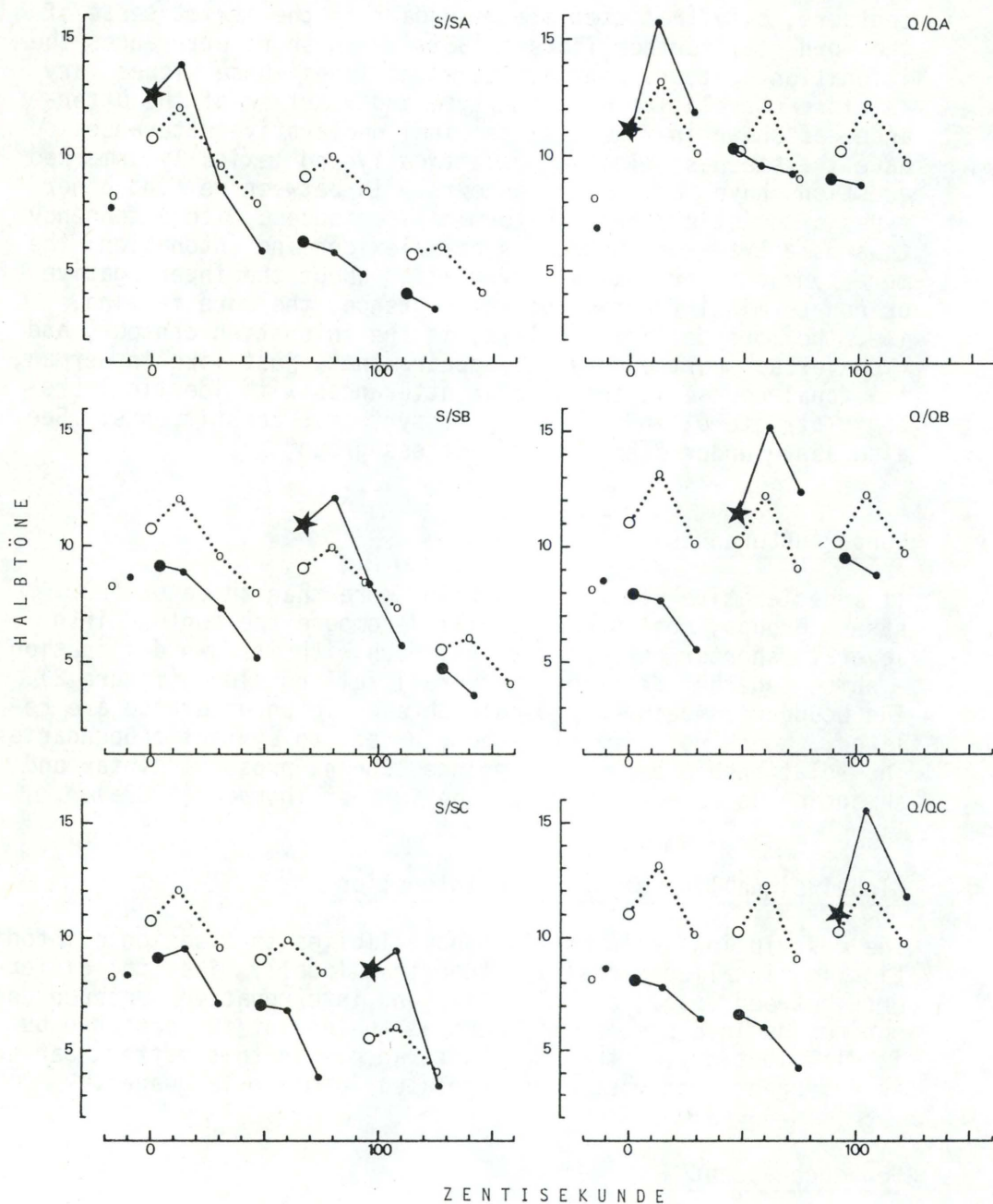
Figure 4

*Stylized tracings of the course of Fo in statements
(S - left) and questions (Q - right), which are pro-
sodically 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 un-
stressed syllables.*

Contrast

Emphasis for contrast is manifested in Standard Danish by a
raising of Fo of the stressed syllable of the emphasized word,
together with a shrinking of the Fo patterns in the neighbour-
ing stress groups (figure 4 and further Thorsen 1980b). Thus,
emphasis for contrast in Danish shares certain features with
the sentence accent of other languages, without being identical
with it. One difference remains, however: in pragmatically
neutral utterances of Standard Danish there is no particular
prominence attached to the last (or any other) stressed syl-
lable.

In the description of Danish, as opposed to German, the follow-
ing points should be noted: In German there is a distinction
between emphasis as an expression of the speaker's involvement
- which is signalled globally, i.e. with larger tonal movements
throughout the utterance - and contrast, which emphasizes a
particular word and which is expressed in and around the stres-
sed syllable. In Danish the parameter "speaker involvement"
has not yet been subjected to investigation. The German
parameter 'contrast' corresponds to the Danish 'emphasis for
contrast'.

Furthermore, in the description of German intonation a distinc-
tion is made between accented and stressed syllables. Accented
syllables are those lexically stressed syllables which are
associated with a tonal change, i.e. a skip (up or down) in
frequency. Any German word may contain a stressed syllable;
this is the word accent. In the sentence, however, words will
often be de-accentuated due to the context, i.e. they will
appear without any tonal movement. Such words, with their
meanings, are not made prominent. This distinction in German
corresponds, in the description of Standard Danish, rather to
the difference between stressed syllables, which are signalled
through a rise in Fo, and syllables with secondary stress which
have no such rise and which we find, e.g., in prosodic stress
groups which surround a word with emphasis for contrast. This
is a point where the description of Danish may have to undergo
a revision; but until the concept of accent is better under-
stood in Danish, the present account will be maintained.

Finally, we wish to point out that certain phenomena, which
are termed emphasis for contrast in Danish might correspond to
the German sentence accent, insofar as the difference between
sentence accent and contrast in German is not a categorical one,
neither semantically nor phonologically/phonetically.

GERMAN INTONATION

The following description of German intonation is based on
phonetic investigations of the speech of ten North German
speakers, where the Fo course is attained through acoustic
analysis and measurements.[2] A more detailed description of
the phonetic background can be found in the references.

Units of description

The basic units for the description of German intonation,
apart from the whole text, are (1) the complete utterance,
whose end is signalled by a very low Fo in answers and by a
very high Fo in questions, tones which simultaneously reflect
the terminal juncture, i.e. the boundary at the end of the
utterance; (2) the phrase, the part of an utterance which is
subordinated to it through tonal (and temporal) means (paren-
theses, subordinate clauses of various types); (3) the foot,
i.e. the part of a phrase which begins with an accentuated
syllable and encompasses all succeeding unstressed syllables.
In certain cases units may merge. For instance, utterances
like Es hat geklópft, Ich doch nicht!, Já, Wiesó? consist
of phrases which are simultaneously feet.

The intonation, i.e. the Fo curves of utterances of varying
length (1, 2, 3 and 8 accents), and the three utterance types:
neutral answer, neutral information question, and surprised
echo question by a North German speaker are shown schematic-
ally in figure 5. Every content word has the same weight.
The time axis (horizontal) is normalized. The Fo rises in
all accentuated syllables until the last one of the answer
(declarative), where it falls. The two question types differ
from the answer mainly at the end, through the rising versus
falling tonal movement. The utterance with three accentuated
syllables, in the three intonational versions is as follows:

    ANSWER   Der Müller will die Männer immer Lümmel
                    nennen.

                    (The miller always calls the men louts.)

    ECHO QUES-   Der Müller will die Männer immer Lümmel
    TION   nennen??!!

    INFORMATION   Will der Müller die Männer immer Lümmel
    QUESTION   nennen?

The different utterance lengths are achieved by reduction and
expansion, respectively, of these sentences.

For the production of intonation in an utterance in German,
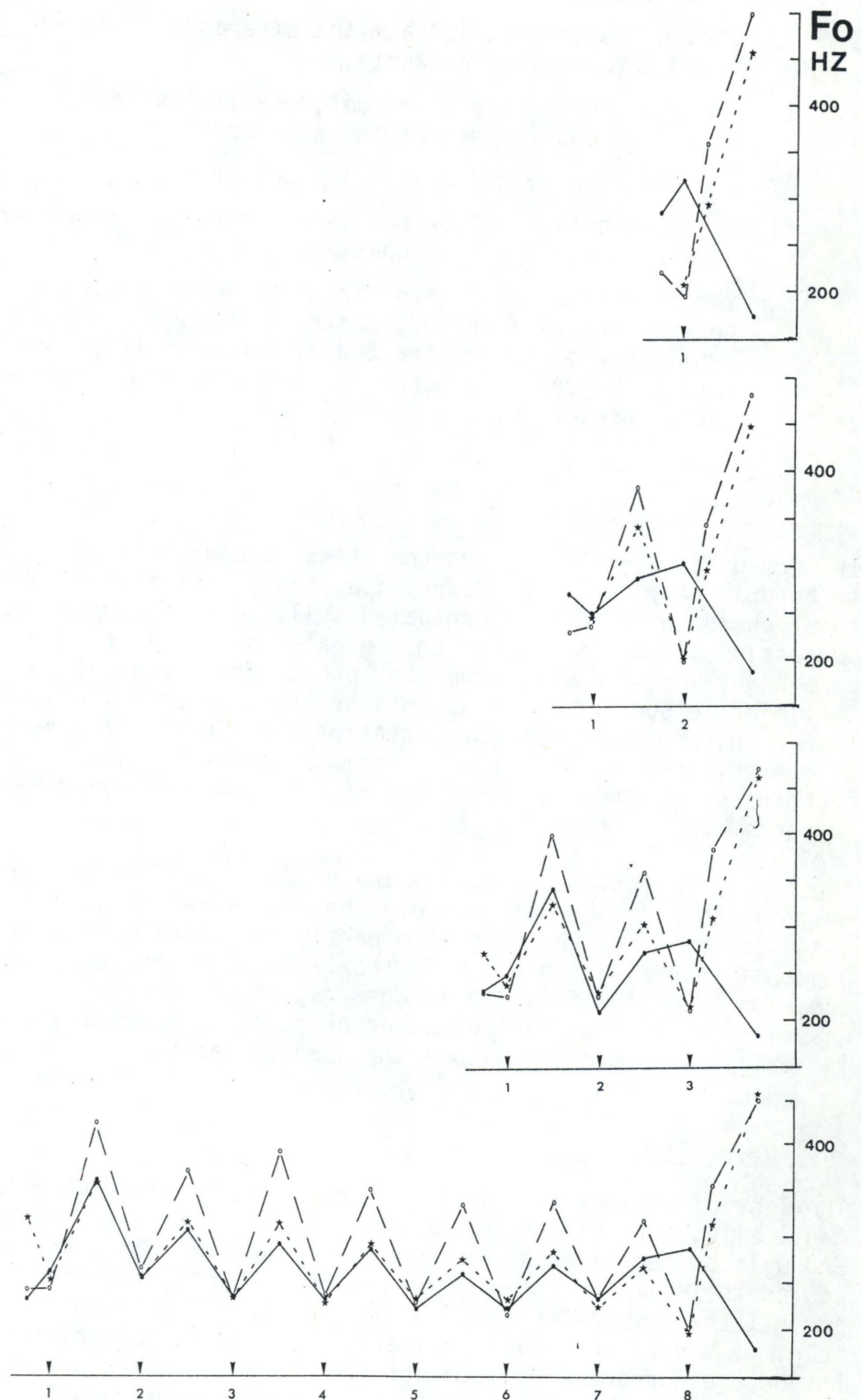the following prosodic information is necessary and sufficient:

Figure 5

*Normalized and superposed Fo tracings of answers, information
questions, and echo questions of varying length.   One to eight
accents.   The last accent is the line-up point.*

1. Beginning and end of the utterance (initial and ter-
   minal junctures),

2. phrase boundaries, in case the utterance is decom-
   posed into smaller elements,

3. the position of the accentuated syllables in the
   lexical items (words) of the utterance,

4. the semantic weight of the lexical units,

5. intonation type (utterance type): terminal in answers
   versus non-terminal in questions,

6. the speaker's involvement in what is being said:
   neutral versus involved, contrast through particular
   prominence of the contrasted element (word) and em-
   phasis through prominence of a whole phrase or utter-
   ance, respectively.

Prosodic characteristics

In German, too, we may assume the stress accent or word accent
to be primarily tonal in nature, i.e. the accent relies on a
tonal change within the accentuated syllable or between two
successive syllables and not on a greater articulatory force
or a higher air pressure from the lungs. Therefore, it seems
justified to speak only of accents or accentuated syllables
in German, whose primary manifestation lies in the Fo movement
of the syllable or in a skip up from the low Fo of the pre-
accentuated to the high Fo of the post-accentuated syllable,
respectively.

The tonal properties are partly independent, i.e. they do not
rely on other properties, notably the rhythmical structure, of
the utterance; but they are also partly connected with other
properties and/or interact with them. So, for instance, in-
tonation type (low final Fo in answers, high final Fo in
questions) is independent of other properties, whereas accent
is lexically associated with a stressed syllable.

Nucleus or main accent

The last of several accents, intended to be equally heavy se-
mantically, in a German phrase will stand out from the others,
and will be perceived as heavier or stronger. This accent is
called the rhematic accent, the sentence accent, the main
accent, the primary accent, or the nucleus ("Schwerpunkt")
(e.g. by von Essen, 1956). Lately, the term (semantic) focus
has become current. The semantic focus, which makes one lexi-
cal item stand out from others, is signalled prosodically
through the main accent. This nucleus may occur with both
intonation types: with terminal utterances it is manifested
in the tonal fall (in the low end point), with non-terminal
utterances it is signalled in the tonal rise (in the high
end point). The stronger auditory impression of the main
accent derives from two properties: firstly, from the tonal

change in the final accent itself, secondly, in the tonal
course from the accent to the end of the utterance.

After the nucleus, no more accentuated syllables will appear
(though there may be stressed syllables), i.e. after the tonal
change associated with the primary accent the Fo curve runs
smoothly towards the low or high end point. Thus, a phrase
contains - besides possible accentuated syllables - only one
nucleus or main accent. The nucleus is no independent unit:
it can be predicted with semantic-pragmatic rules.

An example of nucleus displacement to the left, departing from
an utterance with four accents which was pronounced as one
phrase, is shown in figure 6, (a) as a terminal utterance type
(an answer to a corresponding question or as a general state-
ment) and as a non-terminal utterance type in two editions:
(b) as information question with word order inversion and
(c) as echo question, which expresses, inter alia, surprise
and wonder. It is clear to see that the Fo curve, after the
last, major change in the 4th, 3rd, 2nd, and 1st accentual
position, respectively, runs smoothly low and high, respective-
ly, to the end.

Special prominence

Intonation may also express the speaker's attitude towards the
contents of his utterance, i.e. his involvement in what he is
saying. A strongly participating, involved, emphatic attitude,
e.g. surprise, wonder, indignation, is expressed tonally in a
larger Fo range. The increase of the range, within which the
pitch curve of the utterance varies, is primarily brought about
by a raising of Fo maxima, but also by a lowering of the minima.
This increase of the tonal range covers the whole phrase with
all its accents. Figure 6 shows the echo question (c) in con-
trast to the information question (b) and to the answer (a).

Contrast, on the other hand, does have a semantic-lexical func-
tion, which is signalled tonally to the listener by the same
means, namely an increased Fo range. However, its domain is
limited to the lexical unit, the word. Contrast often expres-
ses an opposition or the correction of an assumption. In
phrases, which consist of only one foot, contrast and emphasis
merge as far as the tonal manifestation goes. The difference
lies, apart from the domain, in the function of the tonal ex-
pression. Contrast and nucleus are also different phenomena.
This appears from figure 7. The curves derive from utterances
which are of identical lexical, syntactic and phonological
structure, but which occur in different prosodic contexts.
The contrast appears tonally as prominent and marked peaks in
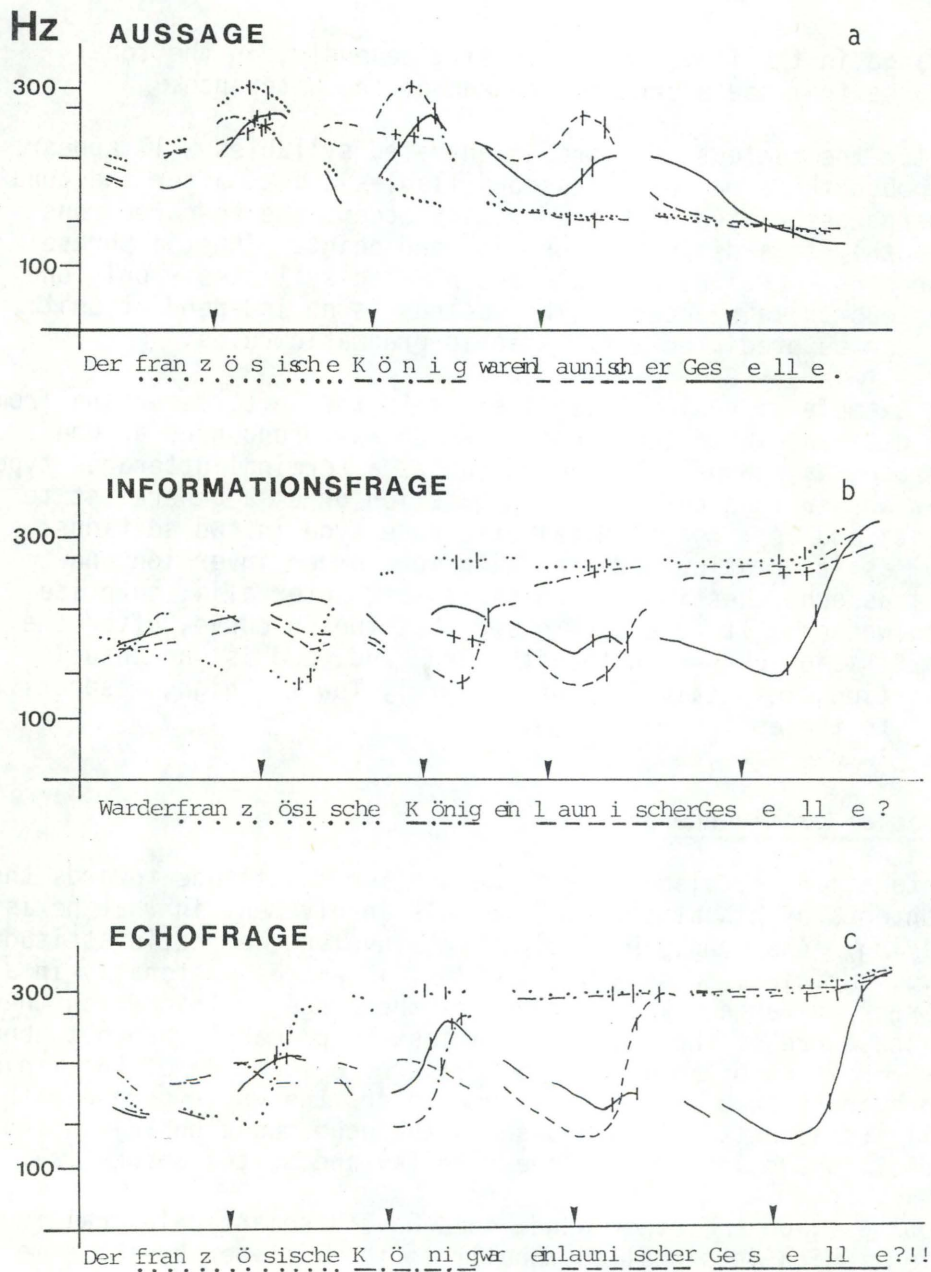each accent position.

Figure 6

Sentence accent in answers, echo- and information questions with
four possible accents (arrows). Superposed tracings from four
versions with the sentence accent in each of the four positions.
The arrows along the horizontal time axis denote the boundaries
between the initial consonant and the accentuated vowel. The
respective accentuated words are underlined in the same type of
line as the Fo tracing. The sentence accent contains the last
tonal change of the utterance.

Phrase intonation

Two junctures (boundary signals), the terminal (utterance final) and the non-terminal (phrase final), have their characteristic tonal expressions. While the former expresses itself through an extremely low or high Fo, respectively, the latter is manifested by an Fo in the middle to upper range of the utterance, the so-called phrase tone. The relation to the Fo course preceding and succeeding the juncture is also part of the total picture of these tonal-junctural phenomena.

Figure 8 shows the syntactically complex sentence "Mánchmal aber, und dann óhne grósse Ánkündigung, blíckte er sie fínster unter einer gerúnzelten Stírn an, dass sie béinahe das Fúrchten bekamen" (Often, however, and without particular warning, he looked severely at them, under dark and knitted brows, so that they were almost afraid.) as a part of a text. The utterance consists of four phrases. Each of the three non-final phrases ends in a high Fo which is reached either in the last syllable of the phrase ("Ankündigung, an") or already in the last accent ("aber"). The end of the last phrase is identical to the end of the utterance. The low Fo in the last syllable expresses simultaneously the terminal juncture and the intonation type 'answer' (statement). This figure also illustrates a natural Fo curve, as delivered by the acoustic analysis. The empty
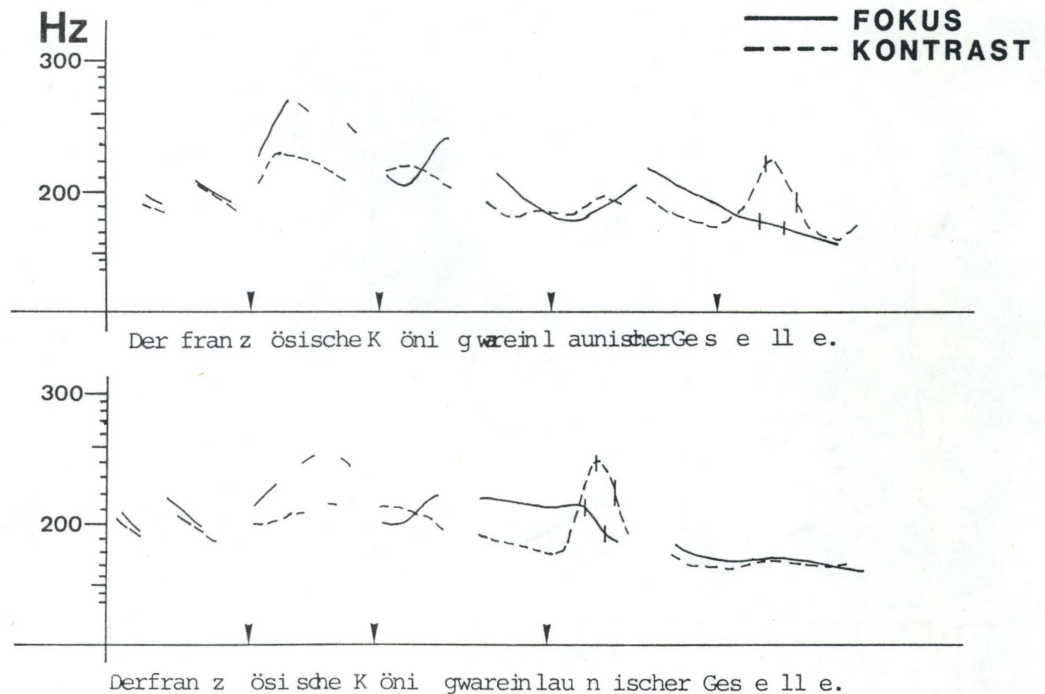

Figure 7

Contrast and sentence accent in a declarative. Fourth and third accentual position.
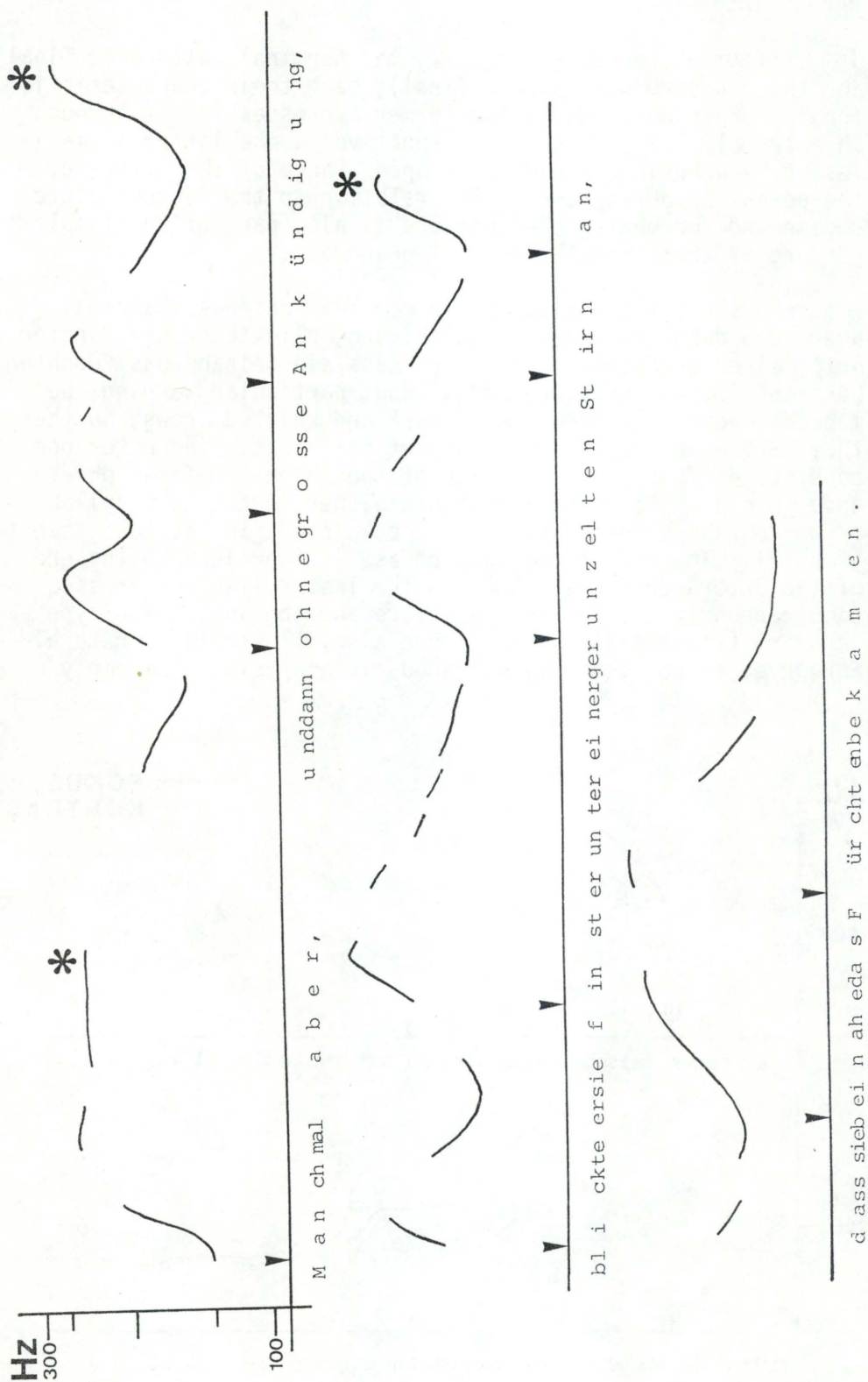
Figure 8

Phrasal intonation and phrase tone. The syntactically complex utterance (declarative) consists of four prosodic phrases. The three non-terminal phrases end in a high, continuation phrase tone, which is denoted with a star.

spaces in the curve correspond to unvoiced segments and phonatory pauses. Both junctures may be, but are not necessarily, accompanied by a physical pause. However that may be, we may assume that both junctures, beside their tonal manifestation, also involve a temporal lengthening of the last syllable, the so-called final lengthening, which has been demonstrated in other Germanic languages like Dutch, English and Swedish as well, but which is not a feature of Danish.

The intonational system

The course of Fo in phrasally identical utterances with equally prominent accents appears in German to be fairly simple and systematic. Apart from the last accent, the nucleus - which simultaneously expresses the intonation type - the tonal course of utterances with several accents appears, grossly simplified, as a repetition of the sequence Low-High(-Low) for each non-utterance final accent. This system for all three sentence types and for sentences with one to eight accents appears clearly from figure 5. The low points (Fo minima) of the accents in the three utterance types form a rather firm floor while the peaks in the utterances may be raised (so for instance in the echo question).

With unequally prominent accents, i.e. when an accent in the phrase, due to less semantic weight, appears weakened relative to a neighbouring one, the high and low points of this accent are displaced towards the middle of the range. The tonal movements of this accent diminish. A complete loss of semantic weight of a lexical element leads to de-accentuation and thereby also to the absence of Fo movements in the potentially accentuated syllable.

The tonal course through an utterance, i.e. the Fo minima and maxima with rising and falling movements between them, is characterized by an overall falling slope. As seen in figure 5, the Fo curve begins with a higher value of the minimum of the first accent than the one on which it ends. Intervening minima are distributed between these two values. This slope on the course of Fo is more or less identical for both utterance types and for the dimension 'involvement', although the echo question often begins with a lower Fo minimum in the first accent than the corresponding statement. Even when this difference is present, it should not be associated with utterance type differences, which are primarily signalled locally at the end of the utterance, but rather as an expression of involvement (in casu: surprise).

In the longest utterances, from five accents and upwards, Fo minima are not evenly distributed between the first and last minimum, as they are in shorter utterances. In the longest utterances a certain re-structuring appears to take place. The Fo minima of the penultimate and antepenultimate accent lie somewhat higher than the preceding ones. It is possible

that this upward displacement of the tonal movements - the
peaks, at least, are raised - takes place in anticipation of
the end of the utterance, which is so rich in tonal informa-
tion.   Thereby it is assured that the tonal change of the last
accent may be really extensive and clear. A comparison with
figure 2 shows that the floor, i.e. the line which connects
the Fo minima, is clearly different from the corresponding
sentences in Danish. The interval between the first and last
Fo minimum in an answer is considerably smaller than in Danish.
This behaviour is a natural consequence of the different tonal
signalling of the intonation types answer and question, re-
spectively, in the two languages, as will appear from the next
section.

Intonation types

In German, answer and question differ very clearly and unam-
biguously with respect to their tonal manifestation. The dif-
ference between answer (terminal) and question (non-terminal)
appears locally at the end of the utterance. The terminal in-
tonation type ends with a low Fo. As a matter of fact, this
point represents the speaker's absolute low, which he repro-
duces fairly accurately and constantly. The non-terminal ut-
terance type ends high and may constitute the auditory pitch
peak of the utterance. As appears clearly from figure 5, the
Fo minima of the various sentence types practically coincide.
From this we may conclude that the overall slope of the pitch
curve, respectively the tonal floor (of the Fo minima), does
not, in German, constitute the signal for intonation type.
In Danish, on the contrary, where intonation type is not sig-
nalled locally at the end, the global tonal difference of the
total utterance must serve to distinguish intonation types.

Tonal range

The course of the Fo curve, i.e. the timing of tonal minima and
maxima, signals linguistic categories, but apart from that the
speaker also exploits the possibility to change the range of
his tonal movements for communicative purposes. With the
speakers investigated so far the tonal movements in answers
and information questions had the same range. Both utterance
types were spoken with normal, neutral involvement. The in-
formation question is a true question, with which the speaker
seeks real, to him unknown information. By strong involvement,
as e.g. in the expression of surprise and wonder or incredulity
in the echo question, most speakers increased their tonal range,
though maintaining the basic structure of the tonal course.
Furthermore, the syllables of the total utterance will be con-
siderably lengthened in some cases. The tonal range is in-
creased primarily by the raising of the Fo maxima. Thereby the
Fo rises and falls in any given accent are increased. This
observation leads to the assumption that the tonal course rests
on a constant Fo bottom or floor, while the height of the ceiling

can be displaced upwards. These tonal relations express phy-
siological-articulatory mechanisms and constraints.

Intonation and syntax

Prosody in general and intonation in particular have a double
function in the grammar. They are associated with other gram-
matical components, on the one hand, but they lead separate
lives, on the other. Accents occur only in lexically deter-
mined syllables; prosodic phrases often coincide with syntac-
tic phrases, but not necessarily. The tonal course of phrases
with the same prosodic structure is identical, whether the
phrase be a nominal, a prepositional, or an adverbial one.
Word boundaries have no influence on the Fo course, as is also
the case in Danish.

SURVEY FOR COMPARISON

From the descriptions of German and Danish intonation above it
appears that similarities and differences exist between the two
languages. By way of conclusion they are summarized here:

Alike or similar are the following properties of German and
Danish intonation: The basic units of description, namely text,
utterance (sentence), phrase, foot, and syllable, which are
hierarchically organized from the largest to the smallest unit.
The (word-) accent is mainly realized through an Fo change in
the accentuated syllable, or an Fo jump. Contrast and emphasis,
i.e. a particular prominence of a word or an utterance, are ex-
pressed through greater Fo range, which is primarily achieved
via a raising of the Fo peaks. Between prosody, in particular
intonation, and syntax relations exist which, however, have not
yet been investigated directly or to any great extent (but see
Tropf 1984).

German and Danish intonation differ on the following points:
In German, the last of several semantically equally prominent
words in an utterance receives the nuclear or sentence or main
accent; this is not so in Danish. In a neutral statement in
Danish all accents sound equally prominent. The intonation
types answer and question, respectively, demonstrate major dif-
ferences. In German their tonal manifestation is located at
the end of the utterance (from the last accent to the end) -
the answer ends in a low Fo, the question in a high Fo. The
preceding tonal course is identical. In Danish, on the con-
trary, answer and question differ globally, in the total course
of Fo which is falling in terminal declaratives and horizontal
in syntactically unmarked questions. At the end, both utterance
types are alike tonally.

These similarities and differences are summarized in Table I:[3]

Table I

Similarities and differences in the intonation of German and Danish

Property	German	Danish	similar?
Units of description		Text (period) Utterance (sentence) Phrase Foot Syllable	yes
(word-)accent		tonal manifestation as fundamen- frequency change (jump)	yes
Nucleus (primary accent)	compulsory	non-compulsory	no
Contrast		increased tonal range in the accentuated syllable and simultaneous tonal reduction in the neighbouring syllables	yes
Intonation types	local signalling: lower final Fo in answers, higher final Fo in questions in otherwise similarly sloping pitch curves	global signalling: falling in terminal declaratives, less falling in other sentence functions	no
Intonation and syntax		no direct, but a rather complex relation	yes

NOTES

1. The stress group or foot consists of the accentuated syllable and all succeeding unstressed syllables (if any).

2. The present description deals exclusively with the basic linguistic units of intonation, i.e. with the basic intonational structure of utterances with a purely linguistic function. Paralinguistic aspects, like emotions or irony as well as voice quality, are excluded. Note also, that as far as we know, the acoustic data on German intonation with their integration in an intonation or prosody model, are the first of their kind. Consequently, the statements made here about German intonation cannot be exhaustive. On the other hand, we assume that the description contains fundamentally valid observations and characteristic features of Standard German intonation. Further data and knowledge in this area are anticipated: due to a recent financial support for intonation research from the German Research Council, there is a lively activity in intonation research going on in the Federal Republic.

3. This comparison is, for various reasons, not complete.

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