

INSTRUMENTAL, AUDITORY AND FUNCTIONAL ANALYSIS  
OF POLISH INTONATION

This paper informs about research results whose aim was to obtain an objective information about the physical structure and some grammatical functions of intonation in Polish. A comprehensive report of this stage of my researches was presented in the monograph "Intonacja wypowiedzi polskich" <sup>1)</sup> published last year.

Among the few publications dealing with the problem of Polish intonation three works are worthy of a particular attention: "Prozodia języka polskiego" by M. Dłuska, <sup>2)</sup> "Zur Satzintonation des Polnischen" by H. W. Wodarz <sup>3)</sup> and first of all "Versuch einer strukturellen Analyse der polnischen Aussagemelodie" by M. Steffen-Batogowa. <sup>4)</sup>

The remarks by Dłuska are based, as indicated in her work, "partially on aural observation, partially on experimental material" obtained by the phonographic method. The author distinguishes two basic intonation contours: the rising contour (anticadence) and the falling contour (cadence). They play a grammatical function in the Polish language. The rising contour expresses non-finality and characterizes utterances denoting appeals, questions and "the first part of a sentence in prose", the falling contour denotes finality and charac-

- 1) L. Dukiewicz, "Intonacja wypowiedzi polskich", 1978, *Prace Instytutu Języka Polskiego*, t. 30, Wrocław-Warszawa-Kraków-Gdańsk, Zakład Narodowy im. Ossolińskich.
- 2) M. Dłuska, *Prozodia języka polskiego*, wyd. I 1947, wyd. II 1976, Warszawa, PWN.
- 3) H. W. Wodarz, "Zur Satzintonation des Polnischen", *Phonetica* 8, 1962, 128 - 146.
- 4) M. Steffen-Batogowa, "Versuch einer strukturellen Analyse der polnischen Aussagemelodie", *Zeitschrift für Phonetik und allgemeine Sprachwissenschaft*, 19, 1966, 398 - 440.

terizes answers, indicative utterances and the last parts of sentences. The work does not contain any diagrams of the fundamental frequency curves based on measurements and occurring in the mentioned utterances, it is also not known what kind of linguistic material was investigated by the author, therefore it is difficult to assume an attitude towards her opinions. However at least two remarks can be made: 1) For some types of Polish questions (for the so-called wh-questions) the falling intonation contour is more typical; 2) Appeals with a rising intonation contour may have a rather regional character. At any rate it is not the only and probably not the most frequent type of intonation contour occurring in such utterances.

Wodarz distinguishes in Polish three "basically different" types of intonation contours: 1) terminal, 2) suspended (continuative), 3) interrogative. The first type occurs in short terminated utterances or in sections of utterances terminating an entirety composed of several parts, in requests, appeals and wh-questions, the second type characterizes utterances preceding the section which completes the whole utterance, the third type characterizes the so-called yes-no questions, in some cases also the wh-questions. The characteristic feature of intonation of neutral terminated utterances is the contour falling to the low position, occurring within the last stressed syllable of the utterance. This syllable has a lower position than all syllables preceding it. The following, not stressed syllable (the last syllable in the utterance), has a level tone contour, maintained on the pitch reached at the end of the last stressed syllable. The intonation of utterances indicating request, appeal and wh-question overlaps in the general outline with the intonation of terminated utterances.

The intonation of the continuative type occurs - according to the observations by Wodarz - in two variants: either the final three syllables of the utterance - the prestressed, the stressed and the poststressed - are pronounced with a stepwise increasing pitch, or the last stressed syllable is pronounced lower than all syllables preceding it, and the poststressed is

elevated to about the level of the syllables preceding the last stressed syllable. A common feature of both variants is the elevated pitch of the poststressed syllable.

In the intonation contour of an interrogative type the last stressed syllable of the utterance is lowered and lies below the level of all preceding syllables. The poststressed syllable is elevated, the tone movement within it is rising and reaches generally a higher level than the level on which the other syllables of the utterance are spoken.

Wodarz evaluated the intonation contours by the auditory method. The contours of some utterance sections were checked instrumentally.

In the description by Wodarz some differences are visible in comparison with the description by Dłuska and also in comparison with my own results which will be discussed later.

M. Steffen-Batogowa presented in her work the first and so far the only one attempt to establish the Polish inventory of functional intonation units. This attempt is based on purely formal, distributive criteria of analysis. The work does not contain any description of the grammatical function of the distinguished units. In the reported stage of my researches I have accepted the system of distinctive features, proposed by the above author, as the basis for the preliminary classification of melodies occurring in the analysed utterance types. This classification plays the role of a test verifying the usability of the considered criteria for a detailed description of the correlation between the intonational and grammatical contrasts and at the same time it is the starting point for the further work on the inventory of intonemes. I have used here the term "melody" instead of "intonation" in order to stress that I am speaking only about the values of the tone pitch since only that was considered in the system of Batogowa. Using the term "intonation" I mean a more complex phenomenon which will be discussed later.

The inventory of intonemes established by Batogowa comprises 26 units. They were distinguished 1) according to the nuclear tone movement, i.e. the tone movement connected with a stress-

unit segment starting with the stressed syllable and continuing until the end of the stress-unit. On this basis 7 kinds of intonemes were differentiated: 1. level, 2. rising, 3. falling, 4. weakly rising-falling, 5. strongly rising-falling, 6. weakly falling-rising, 7. strongly falling-rising; 2) according to the relation which occurs between the maximum and minimum values of the nuclear tone movement and the final values of the melody preceding it in cases in which the stress-unit does not start with a stressed syllable. On the basis of this criterion the following intonemes were distinguished: 1. high, 2. low, 3. full and 4. neutral. Tonal units which represent a neutral intoneme begin with a stressed intonation segment. Considering both criteria theoretically 28 intonemes are obtained, however, Batogowa omitted two intonemes which were not represented in her material.

According to the opinion that intonation is a complex phenomenon, the majority of research material covered in my work is analyzed from the point of view of the changes of three acoustic parameters: fundamental frequency, intensity and duration time. In order to justify the accepted point of view I carried out an auditory and spectrographic analysis of such whispered questions and answers which in normal speech are recognized as interrogative utterances and answers to questions exclusively on the basis of intonation. Experimental results indicate that intensity and/or duration time may function as signals of intonation type. Auditory recognition of the utterance type amounted in whisper from 88 to 92 %.

The basic research material which will be discussed below consisted of 720 normal (i.e. not whispered) utterances and utterance fragments of 15 speakers. All speakers spoke fluent standard Polish. The following types of utterances were analyzed:

- 1) yes-no questions,
- 2) the first constituent of a two-constituent indicative utterance (so-called continuative utterance),
- 3) answers,
- 4) the second constituent of a two-constituent indicative utterance.

I denote the two first types by a common name of non-terminated utterances and the remaining types as terminated utterances. Six different one-syllable words and six different two-syllable words were chosen for the experiment. Each word was pronounced by 15 speakers according to the above mentioned utterance types. Thus there were 90 utterances in each of the one-syllable and two-syllable utterance types. (Aside of the basic material, several dozen more differentiated utterances of one speaker were subject to analysis. Those utterances comprised also requests and wh-questions. Altogether the material presented in my monograph comprised 1077 utterances uttered by 40 speakers.)

All above mentioned utterances were subject to instrumental and auditory analysis and the results were statistically elaborated. An auditory evaluation of the examined material was made by 15 listeners. The task of the listeners was not to tell what intonation features were characteristic for the particular utterances but what type of utterances could be discriminated in the heard text. Result comparison of the instrumental and auditory analysis gives some notion about the relation between a definite classification of utterances and the intonation contour of the given utterance.

Fundamental frequency contours in the examined utterances obtained with the help of a tonograph were examined as realizations of functional units distinguished by Batogowa. I considered only the first of the two criteria used by Batogowa, namely the nuclear tone movement, since all utterances of 15 speakers discussed here constituted stress-units starting with a stressed syllable. According to this criterion the correlation between the utterance type and the fundamental frequency contour type are the following:

## T E R M I N A T E D U T T E R A N C E S

## 1. ONE-SYLLABLE RESPONSE UTTERANCES

Nuclear tone movement:	Number of utterances:
falling .....	64
strongly falling-rising .....	25
other.....	1

## 2. TWO-SYLLABLE RESPONSE UTTERANCES

Nuclear tone movement:	Number of utterances:
strongly falling-rising .....	49
falling .....	17
weakly falling-rising .....	2
weakly rising-falling .....	1
other.....	2
no record of fundamental frequency contour at the end of utterance .....	19

## 3. ONE-SYLLABLE FINAL CONSTITUENTS OF INDICATIVE UTTERANCES

Nuclear tone movement:	Number of utterances:
falling .....	46
strongly falling-rising .....	41
other.....	3

## 4. TWO-SYLLABLE FINAL CONSTITUENTS OF INDICATIVE UTTERANCES

Nuclear tone movement:	Number of utterances:
strongly falling-rising .....	56
falling .....	12
weakly falling-rising .....	3
other .....	3
no record of fundamental frequency contour at the end of utterance .....	16

NON - T E R M I N A T E D U T T E R A N C E S

1. ONE-SYLLABLE INTERROGATIVE UTTERANCES

Nuclear tone movement:	Number of utterances:
rising .....	45
weakly falling-rising .....	44
strongly rising-falling .....	1

2. TWO-SYLLABLE INTERROGATIVE UTTERANCES

Nuclear tone movement:	Number of utterances:
weakly falling-rising .....	81
rising .....	9

3. ONE-SYLLABLE CONTINUATIVE UTTERANCES

Nuclear tone movement:	Number of utterances:
rising .....	42
weakly falling-rising .....	42
strongly rising-falling .....	4
strongly falling-rising .....	1
other	1

4. TWO-SYLLABLE CONTINUATIVE UTTERANCES

Nuclear tone movement:	Number of utterances:
weakly falling-rising .....	79
strongly rising-falling .....	4
rising .....	4
other.....	3

Graphic symbols of nuclear tone movements:

rising.....	↗
weakly falling-rising.....	↘↗
strongly rising-falling ...	↗↘
falling .....	↘
strongly falling-rising ...	↘↗
weakly rising-falling.....	↗↘

As it is visible from the above list, the grammatical contrast between the non-terminated and terminated type of utterances is highly correlated with the contrast between melody contours of the rising and falling type. In the non-terminated utterances there occur mainly realizations of the rising and weakly falling-rising intoneme, in the terminated utterances - realizations of the falling and strongly falling-rising intoneme. The occurrence frequency of the one- or two-direction intoneme variants depends on the number of syllables in the utterance. In one syllable utterances the one- and two-direction contours occur equally frequent or the one-direction contour is more frequent; in the two-syllable utterances there is a definite supremacy of two-direction contours.

In both types of non-terminated utterances, similarly as in both types of terminated utterances there occur fundamental frequency contours representing the same intonemes: rising and weakly falling-rising intoneme in questions and continuative utterances, falling and strongly falling-rising in answers and in the final constituents of indicative utterances. A closer analysis of the fundamental frequency diagrams indicates, however, that those utterances are differentiated by such features not taken into account in the hitherto intoneme inventory as relative interval differences or the pitch level of the whole contour in the scale of the given voice. A correlation analysis carried out between the relative interval value in the fundamental frequency contour and the listener's reaction shows that the higher the interval value in the rising contour, the more responses of the listeners classifying the non-terminated utterance as an interrogative one, on the other hand the decrease of the interval value in the rising contour increases the number of estimations classifying the utterance as a continuative one. Terminated utterances (the correlation analysis took into account only one-syllable terminated utterances since for two-syllable utterances the final value of the fundamental frequency contour was frequently illegible) are more diffi-



cult to discriminate on the basis of this criterion, however, the interrelation is rather distinct: a greater interval in the falling contour is more characteristic for a response to a question, a smaller - for the final constituent of the indicative utterance. (Examples of some correlation diagrams - see pp. 17-18).

Both the data referring to the *i n t e n s i t y* and to the *d u r a t i o n t i m e* point to a certain role of these parameters in stressing the contrast between the non-terminated and the terminated utterances. One can notice a distinct tendency to a more rapid fall of the intensity (expressed in dB/s) in terminated utterances. In two-syllable terminated utterances it refers to the second syllable. The difference in peak intensity values plays a small part in the contrasting of one-syllable interrogative and response utterances, on the other hand in pairs: continuative utterance - final constituent of indicative utterance, a greater value of peak intensity characterizes rather consistently the continuative utterances. In two-syllable utterances all or the majority of non-terminated utterances of the particular speakers is characterized by a higher peak intensity value in the final syllable in comparison with the terminated utterances.

The duration time of the whole fundamental frequency contour contributes mainly, though not very consistently, to the stressing of the contrast between the non-terminated and terminated utterances. The non-terminated utterances are more frequently longer.

The auditory evaluation results indicate that the interpretation of the contrast between the intonation contours of the falling and rising types presented no difficulties to the listeners, on the other hand, the more subtle intonation contrasts, based e.g. on the interval difference between the contours with the same direction of fundamental frequency changes, remained often unnoticed:

## ONE - SYLLABLE UTTERANCES

Type:	Mean discriminability:
non-terminated // terminated	91,7 %
interrogative // continuative	32,8 %
response // final constituent of indicative utterance	20,0 %

## TWO - SYLLABLE UTTERANCES

Type:	Mean discriminability:
non-terminated // terminated	95,0 %
interrogative // continuative	35,8 %
response // final constituent of indicative utterance	23,2 %

I want to quote the opinion of such intonation investigators as R. Quirk, D. Crystal or M. A. K. Halliday who point to the existence of intonation contrasts which are easier or more difficult to perceive and suggest that the grading of intonation differences is correlated with different degrees of linguistic relevancy.

An additional instrumental analysis of the fundamental frequency contours in 96 different utterances of one speaker confirmed the need to include into the distinctive intonation features among others also the difference in relation to interval magnitude and the difference in the relative pitch level of the whole contour. Those properties of fundamental frequency contours differentiate e.g. the interrogative and continuative utterances, the indicative and request utterances and different variants of continuative utterances. (Examples of diagrams.)

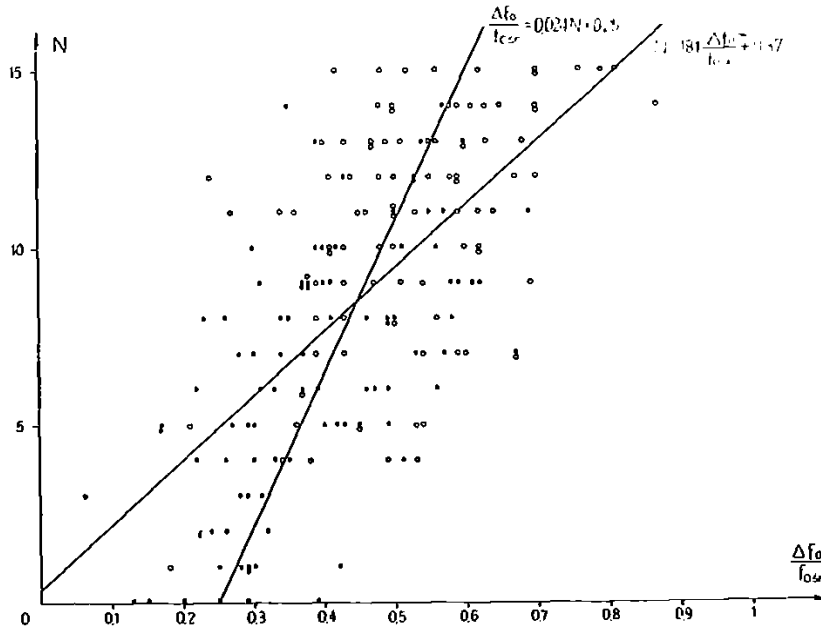


Fig. 1

Correlation diagram

One-syllable non-terminated utterances evaluated by 15 listeners as interrogative utterances

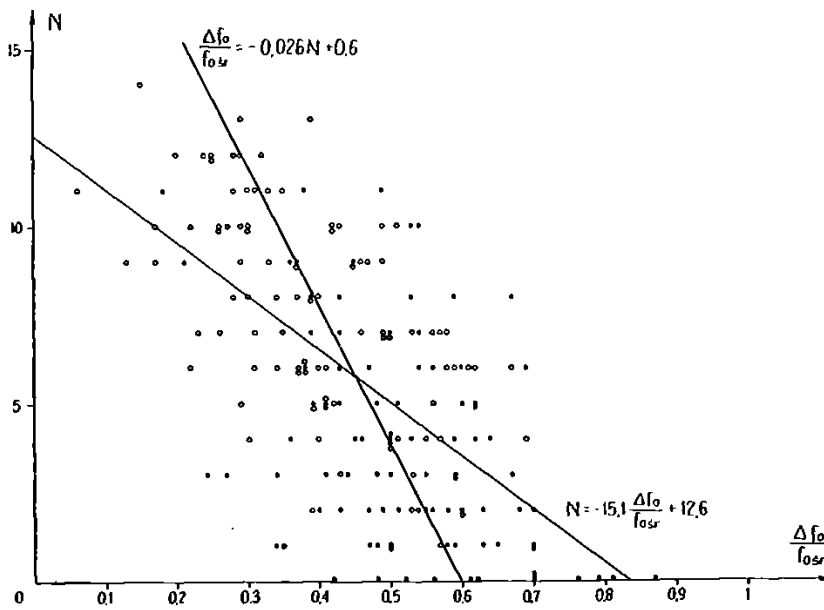


Fig. 2

Correlation diagram

One-syllable non-terminated utterances evaluated by 15 listeners as continuative utterances

Abscissa: Relative interval value  
 Ordinate: Auditory evaluation

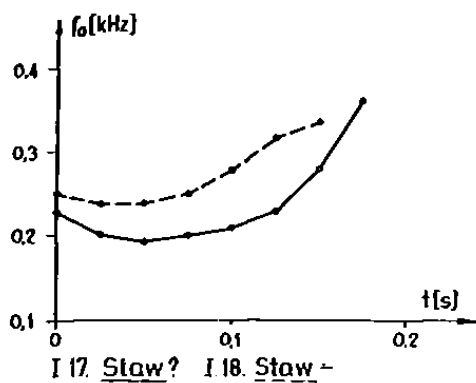


Fig. 3

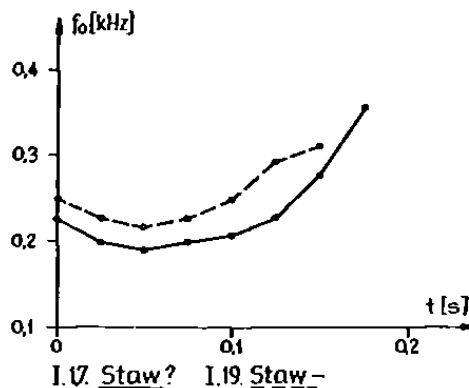


Fig. 4

Fundamental frequency contours:

————— interrogative  
utterances  
- - - - - continuative  
utterances

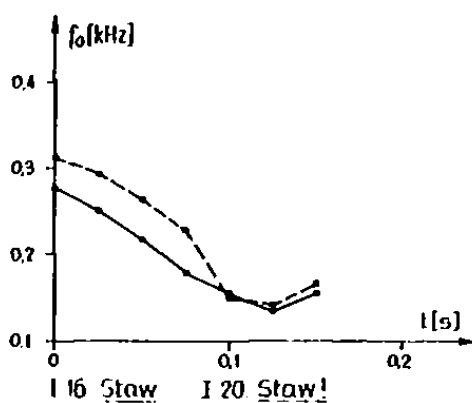


Fig. 5

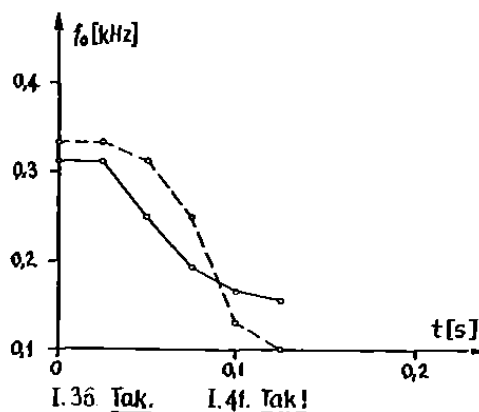


Fig. 6

Fundamental frequency contours:

————— indicative  
utterances  
- - - - - request  
utterances

## DISCUSSION

In the discussion participated: O. Paulsson, S. Gustavsson, S. Urbańczyk, R. Laskowski, Ľ. Ďurovič, H. Wróbel.

The following questions were discussed:

- a) the possibility of delimiting and defining the intonemes (main types and nuances);
- b) how the presence of interrogative pronoun/particle influences the intonation;
- c) the physical (acoustic) correlate of emotional or expressive meanings;
- d) the similarity between the intonemes in different Slavic languages (the relation to Bryzgunova's research). (e)