

The Analysis of Polish Intonation by Synthesis

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1. Introduction

Intonation as a means of expressing thoughts and emotions has an important role in understanding the message conveyed by speech. Therefore it is necessary to study its components, to describe them systematically, and to use results of the analysis in practice. Hungarian and foreign studies show a great diversity of opinions about intonation. Phoneticians do not have a uniform view of the term itself.

These different views can be divided into two large groups: the first one gives a "narrow" and the second one gives a "broad" interpretation of intonation. Intonation in the narrow sense refers to the tune as produced by changing the fundamental frequency. According to this view intonation is determined by a single component, and the interrelated acoustic parameters (i.e. the elements based on intensity and temporal factors) which accompany – or more exactly covary with – the changes of the fundamental frequency are examined independently, as secondary phonetic features, usually called suprasegmental, prosodic or sometimes phonetic features.

In the second interpretation – which has been recently gaining ground – intonation is a phonetic subsystem of more than one acoustic component which is determined by the changes of fundamental frequency, intensity and temporal components (quantity, tempo, rhythm) and elements of sound quality. However, it has to be noted that there is no agreement among phoneticians about the definition of the elements which constitute intonation – sometimes not even on opinions concerning the intonation system of one and the same language.

In my study the terms "intonation" and "speech intonation" are used synonymously with the term "phonetic construction" as defined by Kálmán Bolla. In this sense intonation – like speech sounds – is a complex unit of many components. Speech sounds can be characterized acoustically by determining their pitch, intensity, length and spectrum. Phonetic structure is also determined by these factors. Thus, as a result of the nature of its constituents, intonation is a linguistically relevant independent phonetic subsystem which can be viewed and described physically.

This paper presents the results of analysis and synthesis of Polish assertive, interrogative and negative sentences. The goal of the analysis was to study

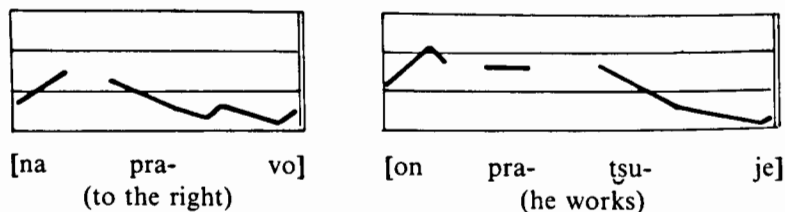
four elements of the intonation of speech (tempo, rhythm, tune, intensity). The synthesis was the verification of the data measured during analysis.

The recordings were made in the Acoustic Phonetics Laboratory of the Polish Academy of Sciences in Poznan. The corpus consisted of 150 sentences – simple, complex and incomplete – which were compiled as to fit the goals of the analysis. The recordings made with Barbara Klusinska were used in the experiment. The measurements were carried out with an FFM 650 Fundamental Frequency Meter, an IM 360 Intensity Meter, a 34 T four-channel mingograph, a PDP 11/34 computer and an OVE III speech synthesizer.

2. Results

The analysis of the intonation patterns of the sentences yielded the following results:

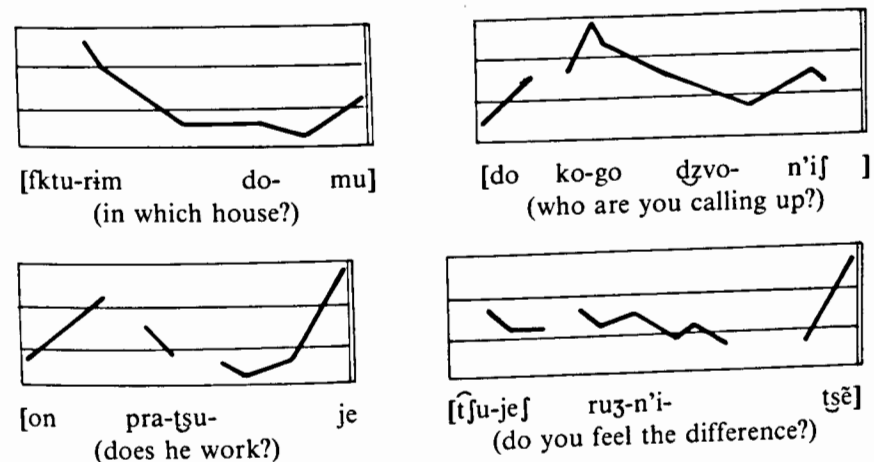
1. Polish affirmative sentences have a characteristic relatively steady rhythm, a relatively narrow register, a steady slightly falling and a slightly rising–falling tone, i.e. there is no abrupt change in the fundamental frequency.



I measured 9.3 sounds/s as the average tempo of the examined Polish affirmative sentences. The tempo of the affirmative sentences was the slowest in relation to the types of interrogative and imperative sentences. The rhythm of the statements could be described as even, the duration data of the syllables compared to each other did not show any bigger change. The pitch of fundamental frequency fell on the first or second syllable of the sentence. The values of F_0 are less as compared to interrogative and imperative sentences, while no abrupt change of F_0 can be observed. The direction of change in intensity of affirmative sentences can be increasing–decreasing and increasing–equal–decreasing, their dynamics changed slightly according to the degree of change in intensity. Fundamental frequency and intensity usually occurred in parallel.

2. The question word questions and the yes-no questions examined are similar in the sense that compared to the imperative sentences their register is wider and their rhythm is usually accelerating–decelerating. The intonation pattern of the two types of interrogative sentences is different: the question

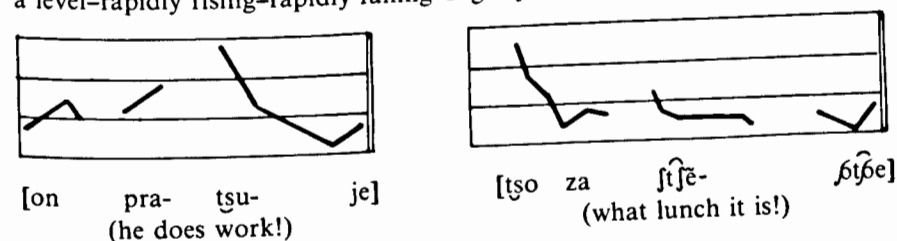
word type is characterized by a rapidly falling–slightly falling–slightly rising tone or a rapidly rising–rapidly falling–slightly falling tone; yes-no questions, on the other hand, are realized on a slightly falling–rapidly rising tone or on a slightly rising–slightly falling–rapidly rising tone. Thus the abrupt change in the fundamental frequency is at the beginning of the sentence in the former case, while it is at the end of the sentence in the latter one.



The tempo of yes-no questions was 9.94 sounds/s, which is quicker than the affirmative and imperative sentences, but it is slower than in question word questions. Their rhythms are variable, they are generally quickening and slowing down. The changes of fundamental frequency were always on the last syllable of the sentences. The changes of intensity occurred on the first and/or the second syllable, the minimum values fell on the last syllable. The dynamics of the sentences showed slight change.

Among the examined types of sentences the tempo of the question word questions was the quickest, it was 10.8 sounds/s. Their rhythms slowed down, more rarely equal/quickening–slowing. The F_0 -pitch values – with the exception of the one word questions – always occurred on the first and/or on the second syllables of the sentences. The change of intensity and fundamental frequency took place in parallel. The direction of the change in intensity was mainly decreasing.

3. Imperative sentences are characterized by a wide register, a changing rhythm and a rapidly rising–slightly falling, rapidly falling–slightly falling or a level–rapidly rising–rapidly falling–slightly falling tone.



The average tempo of the imperative sentences was 9.5 sounds/s, which is higher than that of affirmative sentences, but it is less considering the types of the two questions. Their rhythms are strongly variable, generally quickening–slowing. The place of changes of F_0 and intensity varied but they generally fell on the first syllable, and usually occurred in parallel. According to the direction of change in intensity the exclamations were decreasing, strengthening–decreasing, equal–decreasing or strengthening–equal–decreasing.

3. Conclusion

Intonation patterns characterizing the different sentence types are produced by considerable variation of the value changes of the components. Thus, the changing acoustic components produce different patterns which have linguistically different functions. Thus, as a result of the nature of its constituents, intonation is a linguistically relevant independent phonetic subsystem which can be viewed and described physically.

Comparing the intonation pattern of Polish and Hungarian sentences, I have found that the greatest difference is in the yes-no questions. The Hungarian intonation pattern in this case is usually slightly falling while it is rapidly rising in Polish. There is a greater similarity between the Hungarian and the Polish assertive and imperative sentences. The register of the Polish native speakers is wider, but there are no marked differences in the tempo of speech.

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