A PERCEPTUAL ANALYSIS OF RUSSIAN INTONATION: SOME ASPECTS

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0. ABSTRACT

The method of stylizing pitch phenomena developed at the Institute for Perception Research (IPO) in Eindhoven, the Netherlands, has been shown to be applicable to Russian intonation. In this method, measured Fo curves are represented by the smallest number of straight-line pitch movements which will still yield perceptual equality with the original Fo curve. The aim of the research is to describe Russian intonation in terms of perceptually relevant pitch movements that combine to form complete stylized contours. On the basis of a perceptual analysis, problems on the phonetic and linguistic level can be solved.
Two of the problems encountered so far are highlighted:
1. In an excerpt of running speech a sawtooth shaped intonation pattern was found to occur frequently. This pattern seems to be associated with non-main pitch accents preceding the final pitch accent before a boundary.
2. In the same excerpt, pitch movements are described as moving between a high and a low reference line. However, in order to account for all pitch movements that reach a perceptually relevant point, more reference lines must be distinguished in the broad field between these lines.

1. INTRODUCTION

This paper deals with some aspects of the perceptual analysis of Russian intonation. Such an analysis is different from earlier approaches to the subject. To my knowledge, no perceptual analysis with a high degree of explicitness attained by means of the stylization method (see section 2) has been made of Russian intonation. This method has been successfully applied to Dutch, British English, American English and German, and has proved to be applicable to Russian as well.
On the basis of a perceptual description, more can be said about the linguistic function of Russian intonation. A linguistic description of Russian intonation, together with the explicit perceptual description, is a prerequisite for teaching intonation.
A study of intonational meaning presupposes a perceptual analysis. The reverse does not hold true.

2. METHOD

The method of stylizing pitch phenomena analyses intonation using the Linear Predictive Coding (LPC) analysis by resynthesis system (see Fig.1). This method is known as the Dutch School of Intonation; it has been developed at the Institute for Perception Research (IPO) in Eindhoven, the Netherlands, by A. Cohen, R. Collier and J. 't Hart (e.g. 1973, 1975).
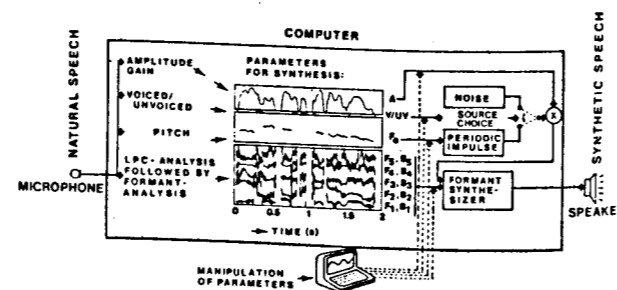
Fig.1: The analysis by resynthesis system (Nooteboom and Cohen, 1984)

The measured original fundamental frequency curves are represented by the smallest number of straight-line pitch movements which will still yield perceptual equality with the original Fo curve.
In the process from original Fo curve to the final stylized pitch contour three stages can be distinguished:
1. Measurement of the original Fo curve.
The original speech signal is digitized and analysed into thirteen parameters: voiced/unvoiced, amplitude, source frequency, five formants and their bandwidths (see Fig.1).
2. Comparison of the resynthesised speech signal with the original speech signal.
All whimsical, small fluctuations can now be removed from the pitch curve by listening and comparing the resynthesis and the natural signal. No differences should be heard between the two signals. Only then is a basis for further stylizations achieved.
3. Stylization of the pitch movements in the "clean" Fo curve.

In interaction with the computer, the Fo curve is reduced to the smallest number of straight-line pitch movements in such a way that perceptual equality between the original Fo curve and the stylization is still observed (see Fig.2). The stylized pitch movement can be made audible and compared with the original Fo curve of the same fragment of the speech signal. No differences are audible. Native subjects can verify the acceptability of the stylization.
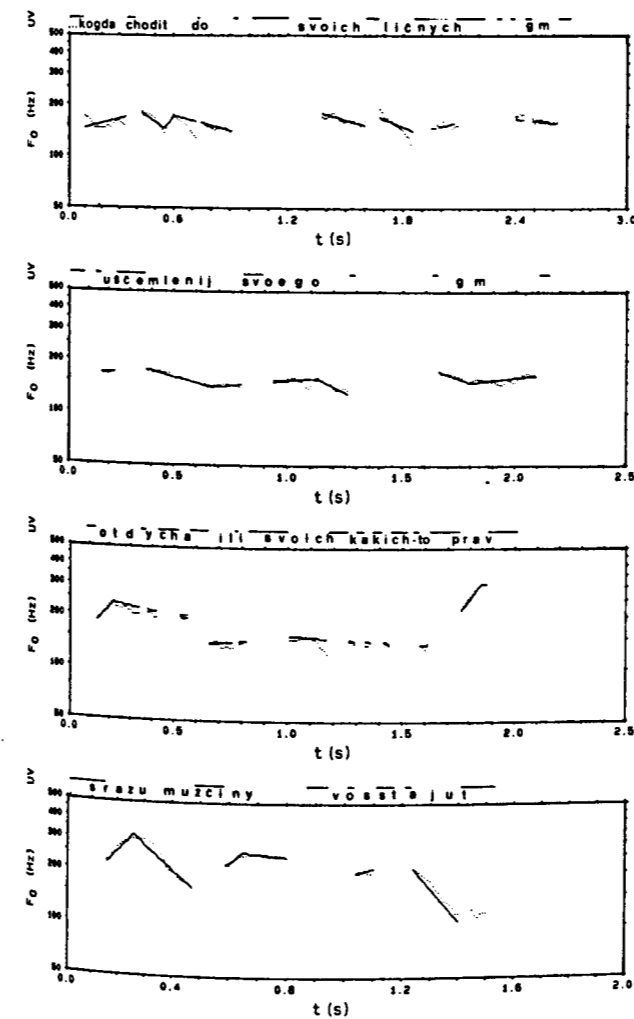
Fig.2: The original Fo curve (dotted) and close-copy stylization (solid) of the Russian spontaneous utterance (in word-to-word translation): ... as soon as it comes to their ... personal ... uh ... restrictions of their ... holiday or some of their rights men immediately revolt

A verified stylized pitch movement is called a close-copy stylization in the sense of De Pijper (1983).
The result of the process described above is a representation of Russian intonation in terms of perceptually relevant pitch movements that combine to form complete stylized contours.

3. AIM AND MOTIVES

The aim of the present research is to represent larger fragments of Russian spontaneous speech in stylized pitch contours. I was encouraged by the studies of Svetozarova (1982) and Keijsper (1983) to formulate the following issues for perceptual research:
1. The number of discrete pitch movements in Russian;
2. The positions in which pitch movements occur within the contour;
3. The possible combinations of pitch movements;
4. The acceptable tolerance within pitch movement parameters;
5. The linguistic function of perceptually relevant pitch movements.
It is expected that the perceptual approach will contribute to elucidating these issues.

4. SOME ASPECTS

So far, an excerpt of Russian spontaneous speech (2 min.) has been fully analysed and described in terms of stylized pitch contours (Odé, 1986). Apart from some questions I had to face while analysing the excerpt, two problems were encountered in particular:
1. a sawtooth shaped intonation pattern was found to exist;
2. the number of reference lines and the exact distance between them in semitones could in most cases not be easily defined.

4.1 The sawtooth pattern

The intonation pattern which I call the sawtooth because of its shape, consists of a sequence of one or more pitch accents in non-final position. The prominent syllables in the sawteeth in one sequence either rise or fall (the bold line indicates the accented syllable):
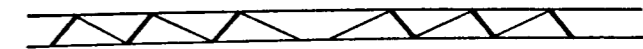
This combination of pitch movements occurs frequently in the above mentioned excerpt. The sawtooth pattern precedes the final pitch accent before a boundary. The establishment of the sawtooth pattern is important. It is an explanation for the fact that many pitch accents that can be found in Russian spontaneous speech do not belong to any of the intonation constructions as described by Bryzgunova (1977). Furthermore, the sawtooth pattern may possibly contribute to the solution of an important linguistic problem: what is the reason for the fact that prosodic grouping of words in a Russian phrase does not always coincide with the syntactic structure of that phrase? Probably a prosodic group of words consists of a rising (falling) pitch accent followed by an unaccented falling (rising) part until the next accent.

Pitch accents of the sawtooth type differ from all other pitch accents that were found in the same excerpt. Modifications of sawteeth into another pattern, e.g. a pointed hat or terrace pattern (a frequent pitch accent in Dutch) were not acceptable for native speakers of Russian.

These considerations have brought me to a first careful conclusion that the sawtooth pattern

a) has not yet been described as a Russian intonation pattern;

b) consists of non-main pitch accents in non-final position;

c) groups together words prosodically which do not necessarily belong together syntactically.

Further analysed speech material seems to support these statements.

An explicit phonetic description of the sawtooth pattern can not (yet) be given. There is much varation in excursion and duration within the pattern, which makes the other features, e.g. the position in the phrase, even more important.

The problem of a phonetic description leads to the second aspect that I would like to examine in this paper: the definition of the reference lines between which pitch moves.

4.2 The reference lines

The question about the reference lines in Russian intonation is twofold:

How many reference lines are to be distinguished and, particularly, how can these lines be defined, that is: how many semitones separate the lines from each other?

Assuming that pitch movements can be described as moving between a high and a low reference line, one question arises immediately: how to handle the fact that in spontaneous Russian speech not all pitch movements have the same size? How can this phenomenon be described in terms of reference lines?

We cannot simply divide the field between the high and low line into two equal parts and assume a middle reference line (see Fig.3) if such a line does not separate perceptually relevant whole pitch movements from perceptually relevant non-whole pitch movements. Non-whole pitch movements are not always the half of whole pitch movements.
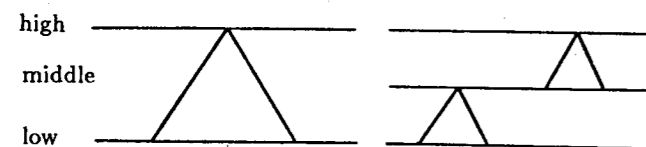

Fig.3: Whole pitch movements and pitch movements that are the exact half of whole pitch movements

If half pitch movements indeed exist and move between low and middle or middle and high reference lines, how can

we define the lines on which non-half and non-whole [movements (pitch movements that are not the exact he whole pitch movements) start or end?

In the analysis of different types of spontaneous Rus speech whole and non-whole pitch movements were fo The non-whole pitch movements were usually not the of whole pitch movements. Rather, instead of one mi reference line, it seems more appropriate to assume a high and a non-low reference line. Movements that do reach the high, non-high, low or non-low reference line at points in the field between the non-high and non-low erence line. No further subdivision of this field seems to possible (see Fig.4).
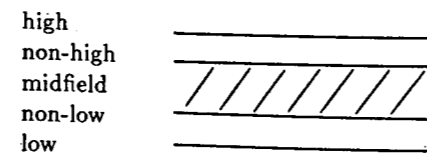

Fig.4: The subdivision between high and low reference li

The assumption of such a subdivision is suggested by variety of frequent non-whole pitch movements of the lowing type (see Fig.5):
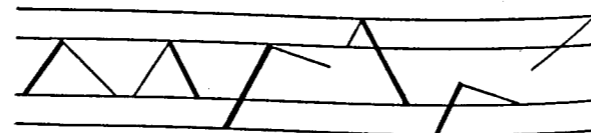

Fig.5: Non-whole pitch movements (the bold line indica the accented syllable): a few examples. The thin I demonstrates the direction of the pitch movement in t unaccented pre- or posttonic parts.

The subdivision indicated in Fig. 4 and Fig. 5 is releva for the perception of pitch movements. This means th this subdivision is also linguistically relevant. The subdi sion is not only relevant for the recognition of pitch mo ments within the accented syllable, but also for percepti relevant distinction in posttonic syllables. In the followi

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examples the accented syllables are perceptually identical, but the posttonic syllables ensure that the configurations differ from each other perceptually. Where the accented part occurs in isolation, e.g. in final position, this difference is neutralized (see Fig.6).
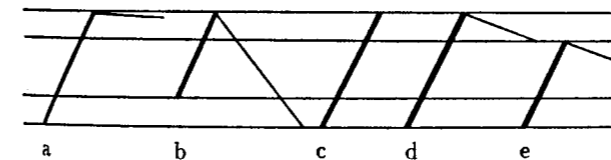

Fig.6: Pitch movements with an identical rise (the bold line indicates the accented syllable) but different posttonic syllables: a) rise + high posttonic part, b) rise + falling posttonic part, c) rise + no posttonic part in final position, d) rise + posttonic part gradually falling to the non-high level, e) rise to the non-high level + posttonic part gradually falling to the midfield.

b) and c) are always clearly different from a), d) and e). A perception experiment has been devised to verify whether a) and d) and d) and e) are indeed discretely different.

5. DISCUSSION

The solution of the two problems described in section 4 contributes to the establishment of an inventory of discrete pitch movements and discrete reference lines between which pitch moves.

If non-main pitch accents must be distinguished from main pitch accents and if the position in which the two types of pitch accents occur can be defined, the issue touches upon the discussion about how prosodic groups and prosodic boundaries can be established. If prosodic boundaries and syntactic boundaries do not coincide, i.e. if syntactic structures do not prescribe prosodic grouping or vice versa, then the issue has important linguistic consequences. It is beyond the scope of my research and this paper to go into detail, but the phenomenon should at least be mentioned here.

The subdivision between high and low reference lines indicated above can solve the problem of the great number of pitch movements that do not fit into a model that distinguishes only between whole and half pitch movements, i.e. a high, middle and low reference line. My description separates from each other pitch movements or configurations of pitch movements that perceptually differ in a very subtle way (see Fig.6, a), d) and e)), but that are probably non-identical.

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6. CONCLUSION

The perceptual analysis of Russian intonation has proved to be an appropriate approach to describe pitch movements. At the same time, it stimulates the linguistic discussion of accent and intonation theory. The research also serves a practical purpose. It can be expected that on the basis of a perceptual description of Russian intonation better results will be achieved in the teaching of this often neglected subject. A replacement of the traditional impressionistic way of teaching intonation by an explicit perceptual, phonetic and linguistic description in an audiovisual course with audiovisual feedback will motivate both students and teachers to study intonation.

It is nothing new that a foreigner, even one who speaks the foreign language very well, can usually be recognized by his/her intonation and even be identified as, for instance, a native speaker of Dutch.

7. REFERENCES

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